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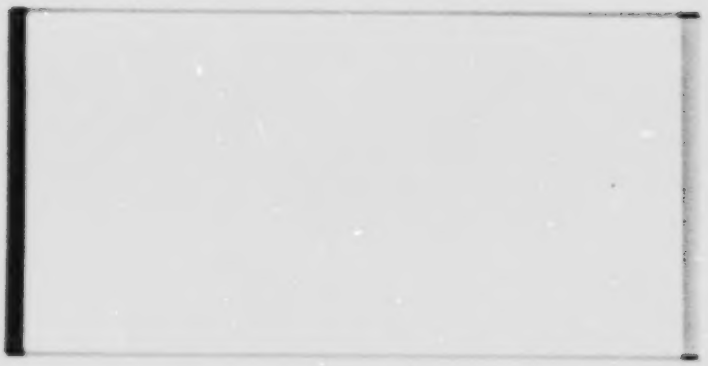

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POST-OPERATIONAL ASH CELL GROUNDWATER QUALITY STUDIES - 1983 THUNDER BAY TGS EXTENSION

Report No 84-108-K

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ABSTRACT

Data on the physical and chemical characteristics of groundwaters from the coal ash storage area at Thunder Bay TGS, for 1983, are presented in this report. The 1983 data show the groundwater quality to be essentially similar to that of the previous years with the possible exception of the increases in concentrations of magnesium in some waters since 1980. A more detailed analysis of all data will be given in the 1984 summary report that will be prepared after the data for the 1984 survey becomes available.

job	file	date	report no.
740631-111-492	837.71	July 20, 1984	84-108-K

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To Dr. W.R. Effer
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POST-OPERATIONAL ASH CELL GROUNDWATER QUALITY STUDIES - 1983 THUNDER BAY TGS EXTENSION

J. Complak

INTRODUCTION

A survey of groundwater quality in the vicinity of the coal ash disposal site (Cell No 1), at Thunder Bay TGS (TBTGS), was conducted during 1983. This survey is a continuation of the 'pre-operational' groundwater surveys conducted by London Monenco Consultants (LMC) during 1976-78/1,2/ and by Ontario Hydro during 1979-81/3,4,5,6/ and the 'post-operational' survey conducted by Ontario Hydro during 1982/7/. Because of manpower and budgetary restraints, the 1983 survey is a reduced program. The 1983 data on groundwater quality are summarized in this report.

The purpose of the 'pre-operational' surveys was to obtain baseline data on the local hydrology and on groundwater chemistry. The survey for 1983, the second year of a planned three year program, was conducted to obtain 'post-operational' data for design verification purposes. The 1983 data is needed for comparison with the 'pre-operational' data to help identify possible changes in groundwater quality caused by ash storage and seepage of ash leachate into the ground.

These surveys are being conducted at the request of Ontario Hydro's Environmental Studies and Assessments Department on behalf of the Thunder Bay Project. Monitoring of groundwater quality is required as part of the conditions of the Certificate of Approval issued by the Ministry of the Environment for the coal ash disposal site for Thunder Bay TGS.

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ASH CELL HISTORY - TO END OF 1983

The following is a brief outline of the main events in the history of the Ash Disposal Cell No 1, which consists of nine sub-cells, shown in Figure 1.

1. Construction of Cell No 1 was completed by August, 1978.

2. Placement of slurry of wet (leached) bottom ash and fly ash from Unit No 1, burning US bituminous coal, into sub-cell No 1, began in June, 1979.

3. Placement of dry fly ash from Unit No 1 began in September 1980.

4. Placement of dry fly ash and bottom ash from Units No 2 and 3, burning Western Canadian lignite coal, began in May 1981, during burn trials.

5. Unit No 2 was in commercial service since September 1981. Unit No 3 came into commercial service on July 14, 1982.

6. Table I shows the volumes of ash placed during 1983.

TABLE I

ASH DISPOSAL INVENTORY - 1979-83
CELL NO 1 - TBTGS

Date	Bituminous Fly Ash m^3	Lignite Fly Ash m^3	Lignite Bottom Ash m^3	Total Ash Placed m^3
To end of 1979	3,430	-	-	3,430
To end of 1980	21,010	-	-	21,010
To end of 1981	18,755	22,571	3,737	45,063
To end of 1982	16,640	57,485	25,974	100,099
January, 1983	-	9,393	4,343	
February	395	9,711	4,115	
March	-	11,505	3,308	
April	-	7,884	2,058	
May	-	6,107	856	
June	-	3,292	98	
July	-	4,760	380	
August	-	8,110	610	
September	-	8,724	2,123	
October	-	12,411	2,880	
November	-	9,431	2,872	
December	(some but amount not known)	8,543	3,424	
1983 Totals	395	99,871	27,067	127,333
Cumulative Totals	60,230	179,927	56,778	296,935

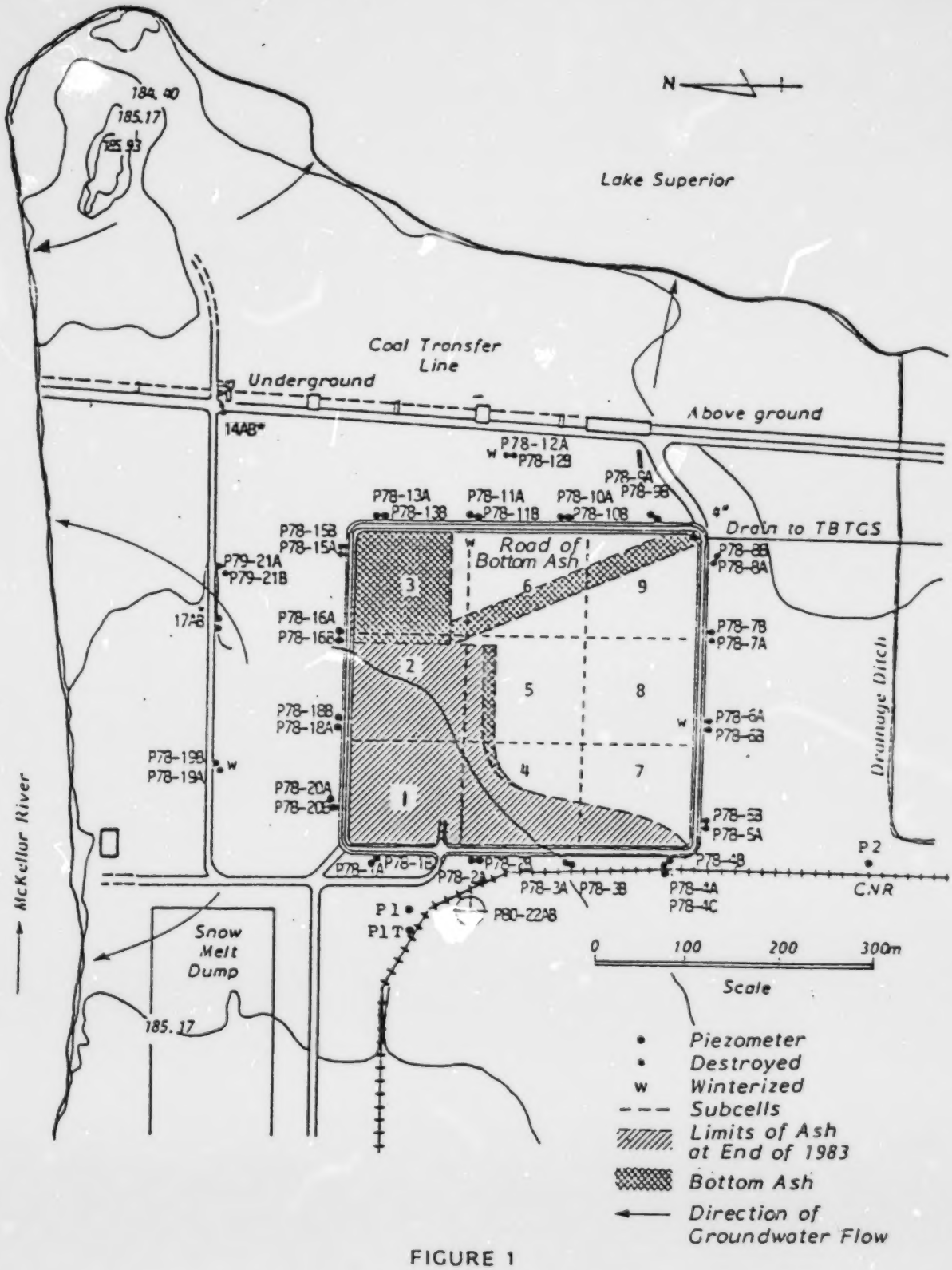

FIGURE 1

ASH DISPOSAL CELL NO. 1
PIEZOMETER NETWORK & LIMIT OF ASH DISPOSAL
THUNDER BAY TGS

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METHODOLOGY

The procedures used to obtain the raw data needed to characterize the hydrology and the quality of the run-off and the natural groundwater in the coal storage areas were similar to those used previously with the following exceptions:

(1) Piezometer level measurements were carried out in the spring only rather than in the spring and fall.

(2) Groundwater levels were measured on five occasions only, between June and October, rather than at monthly intervals throughout the year.

(3) Three groundwater samplings were planned but only two were carried out. Three or more sets of samples were taken in the past.

1. Piezometer and Groundwater Level Surveys

Measurements of piezometer elevations were conducted by Civil Research in May. Groundwater levels were measured in May, June, August, September and October by TBTGS personnel. Both sets of measurements are reported as elevations relative to the average Lake Superior shoreline level of 182.88 m (600 ft) for the Thunder Bay area.

2. Groundwater Sampling

Groundwater sampling by station personnel was scheduled for May, June and August to provide data representing wet and dry season conditions. In general, the following water level measurement and sampling procedures were followed.

(a) Bailing
- Groundwater levels in each piezometer were measured and recorded.
- The water from each piezometer was bailed out with a hand-operated pump or a vacuum pump.
- Four days later the water from each piezometer was bailed out again.

(b) Sampling
- One day after the second bailing in (a) 1 L of groundwater from each piezometer was collected into an acid cleaned LPE bottle.
- The water's pH and conductivity were measured immediately with portable pH and conductivity meters.

(c) Preparation
- All samples collected were kept in a refrigerator at about 4°C.

- The samples were filtered as soon as possible using 0.45 µm prewashed membrane filters.

- A pretreated 500 mL LPE bottle was filled with the filtrate to which were added 2.5 mL of "ULTREX" HNO_3.

- A portion of the remaining filtrate was used for selected field tests.

(d) Shipping - The remaining filtrate (from c) was kept at about 4°C in a cooler with ice packs and shipped, together with the acidified samples, to Research Division, by Air Express, for analysis.

3. Groundwater Tests and Analysis

(a) Routine Analysis - TBTGS and Research

Groundwater samples taken in May and August were tested at TBTGS for pH, conductivity and alkalinity. The August samples were tested at Research for Ca, Mg, Na, K, Cl, SO_4, B and Sr concentrations as well as for pH, conductivity and alkalinity. Determination of PO_4 was deleted. The scheduled June sampling was missed due to manpower shortage at the station. The usual samplings in October and November were not scheduled this year.

(b) Comprehensive Analysis - Research Division

Comprehensive chemical analyses of groundwater samples taken in May were carried out by Research. The characteristics determined are shown below:

COMPREHENSIVE GROUNDWATER ANALYSIS

Characteristics		Characteristics	
pH		Beryllium	Be
Conductivity		Iron	Fe
Alkalinity	HCO_3 and Total, as $CaCO_3$	Titanium	Ti
Sulphate	SO_4	Manganese	Mn
Chloride	Cl	Vanadium	V
Nitrate	NO_3	Chromium	Cr
*Phosphate	PO_4	Copper	Cu
Calcium	Ca	Molybdenum	Mo
Magnesium	Mg	Silver	Ag
Sodium	Na	Cobalt	Co
Potassium	K	Nickel	Ni
Strontium	Sr	Zinc	Zn
Barium	Ba	Arsenic	As
Aluminum	Al	Boron	B
Silicon	Si	Lead	Pb
Thorium	Th	Selenium	Se
Mercury	Hg	Cadmium	Cd

* The 'soluble reactive phosphorus' present in filtered sample

(c) Analytical Methods

In general, the analytical methods used were essentially those outlined in the Standard Methods for the Examination of Water and Wastewater, 14th Edition, published by the American Public Health Association. Ion chromatography, neutron activation and other instrumental techniques currently in general use by the Analytic Section were also used for some determinations.

4. Rationale

(a) Sampling Periods

The months of May and August were chosen for groundwater sampling to provide data on groundwater quality during the wet (spring) and dry (summer) periods. The wet conditions in the spring are expected to produce leachate, containing high concentrations of dissolved matter from the ash. The dry conditions in the summer are expected to provide a better indication of leachate migration through the dry soil. The scheduled June sampling was not carried out.

(b) Field Tests

Because some parameters of natural waters change after sampling, pH and conductivity were determined in the field on fresh samples, and alkalinity, somewhat later in the station's laboratory.

(c) Comprehensive and Partial Analyses

Due to the greater complexity of the analytical methods required, comprehensive analyses of the samples taken in May, and partial analyses of the samples taken in August, were carried out by the Analytic Services Section of the Chemical Research Department, Research Division.

(d) Parameter Significance

Of the many parameters determined, concentrations of Na, Mg, Sr and B are considered to be the main indicators of ash leachate contaminant migration. Alkalinity and SO_4 concentrations commonly considered to be characteristics of ash leachates, are not considered to be particularly suitable contaminant indicators although they do help in general characterization of water quality. Alkalinity is subject to change in passage through soil and sulphate concentrations are limited by saturation effects. In addition, SO_4 concentrations in the groundwater in the study area have been found to be highly variable. It is also suspected that SO_4 concentrations may be affected by natural biological activity in the peat layer.

Sodium is a major component of ash leachate. Its solubility is not limited by saturation effects and it is not expected to undergo significant attenuation in passage through the sandy silt or peat

layers. The analysis for sodium is considerably less time consuming than for SO_4 further supporting the choice of Na as a leachate indicator.

Occasional checks of Sr and B concentrations in piezometer groundwater samples are also considered useful. Sr and B are specific indicators of ash leachate. Although generally not appearing in concentrations as high as Na, they are present in leachates at levels greater than ten times those in the local groundwater. Determination of Sr and B is relatively easy.

Magnesium concentrations could also serve as a suitable leachate contaminant indicator, however, care must be taken in data interpretation when pH levels of the groundwater are high. High pH levels tend to promote precipitation of Mg thus lowering its dissolved concentration in the water sample. This could contribute to possible misinterpretation of the data.

The contaminant indicators discussed above, and other selected analytical data, such as concentrations of heavy metals, that will be obtained next year on the groundwater characteristics, will be examined in greater detail in the 1984 summary 'post-operational' report to identify any changes that can be attributed to ash placement and leachate seepage into the natural groundwater in the area of the ash disposal site.

RESULTS OF FIELD AND LABORATORY WORK CONDUCTED IN 1983

1. Piezometer Network Level Surveys

A piezometer elevation survey was carried out by the Civil Research Department on May 18, 1983. The 1983 results, together with those obtained in 1979 and 1982, are summarized in Table II. The 1980 and 1981 results are not included in this report but are summarized in Research Report No 84-67-K. Locations of the piezometers surveyed are shown in Figure 1.

2. Groundwater Level Surveys

Measurements of groundwater levels in piezometers on the perimeter of the ash cell were carried out on five occasions during 1983. The results are shown in Table III.

Lake Superior water levels (daily and monthly means) for 1983, obtained from Fisheries and Oceans, Ottawa*, for Station 10050, in the Thunder Bay harbour, are shown in Table IV.

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* Marine Environmental Data, Services Branch, Fisheries and Oceans, Ottawa.

TABLE II

ASH CELL GROUNDWATER QUALITY STUDY - 1982
THUNDER BAY TDS EXTENSION

PIEZOMETER REFERENCE LEVELS
(1979, 1982, 1983)

Piezometer Identification		Piezometer Reference Levels, m (Above Reference Level of 182.88 m)							
		Date Surveyed							
		Nov 2 '79	June 9 82	Δ	Nov 3/82	Δ	May 18/83	Δ	Δ'
P79	1A	2.12	2.17	0.02	2.14	-0.03	2.19	0.05	0.07
	1B	2.24	2.29	0.03	2.26	-0.03	2.29	0.03	0.04
P79*	2A	2.20	2.24	0.03	2.20	-0.04	2.22	0.02	0.02
	2B	2.20	2.25	0.03	2.22	-0.03	2.23	0.01	0.03
P79	3A	2.21	2.26	0.03	2.25	-0.01	2.27	0.02	0.06
	3B	2.09	2.14	0.02	2.11	-0.03	2.13	0.02	0.04
P79*	4A	2.15	2.20	0.03	2.16	-0.04	2.18	0.02	0.03
	4B	2.11	2.14	0.02	2.13	-0.01	2.14	0.01	0.03
	4C	1.98	2.04	0.02	2.01	-0.03	2.02	0.01	0.04
P79	5A	2.12	2.25	0.03	2.22	-0.03	2.28	0.06	0.16
	5B	1.98	2.12	0.04	2.08	-0.04	2.13	0.05	0.15
P79*	6A	1.91	1.97	0.03	1.93	-0.04	1.94	0.01	0.03
	6B	1.91	1.96	0.03	1.92	-0.04	1.94	0.02	0.03
P79	7A	1.81	1.92	0.03	1.88	-0.04	1.86	-0.02	0.05
	7B	1.89	2.01	0.03	1.98	-0.03	2.00	0.02	0.11
P79	8A	1.92	2.02	0.04	1.98	-0.04	1.99	0.01	0.07
	8B	1.85	1.98	0.04	1.95	-0.03	1.96	0.01	0.08
P79*	9A	1.72	1.81	0.03	1.77	-0.04	1.80	0.03	0.08
	9B	1.69	1.71	0.03	1.67	-0.04	1.69	0.02	0.00
P79	10A	1.70	1.80	0.03	1.77	-0.03	1.78	0.01	0.08
	10B	1.73	1.83	0.03	1.79	-0.04	1.77	-0.02	0.04
P79*	11A	1.78	1.82	0.03	1.78	-0.04	1.79	0.01	0.01
	11B	1.79	1.83	0.03	1.79	-0.04	1.80	0.01	0.01
P79*	12A	1.74	1.76	0.01	1.75	-0.01	1.73	-0.02	-0.01
	12B	1.82	1.86	0.02	1.85	-0.01	1.86	0.01	0.04
P79	13A	1.94	2.02	0.02	1.99	-0.03	2.01	0.02	0.07
	13B	1.93	2.05	0.05	2.00	-0.05	2.00	0.00	0.07
P79	15A	2.05	2.09	0.03	2.06	-0.03	2.08	0.02	0.03
	15B	2.34	2.38	0.04	2.34	-0.04	2.35	0.01	0.01
P79	16A	2.05	2.12	0.04	2.08	-0.04	2.11	0.03	0.06
	16B	2.13	2.23	0.06	2.18	-0.05	2.22	0.04	0.09
P79*	18A	2.13	2.20	0.04	2.16	-0.04	2.17	0.01	0.04
	18B	2.31	2.37	0.04	2.33	-0.04	2.35	0.02	0.04
P79*	19A	2.30	2.32	0.02	2.29	-0.03	2.34	0.05	0.04
	19B	2.29	2.30	0.02	2.28	-0.02	2.30	0.02	0.01
P79	20A	2.12	2.19	0.03	2.16	-0.03	2.19	0.03	0.07
	20B	2.10	2.24	0.06	2.21	-0.03	2.25	0.04	0.15
P79	21A	1.97	2.00	0.01	1.99	-0.01	2.02	0.03	0.15
	21B	1.98	1.91	0.01	1.90	-0.01	1.96	0.06	-0.02
P81*	22A	2.15(+0)	2.01	0.03	-	-	1.99	-0.02	-0.16
	22B	2.01(90)	2.17	0.03	-	-	2.16	-0.01	0.15
Culvert Cover		1.92(60)	1.94	0.15	-	-	-	-	-

* Winterized wells.
* New wells - installed and elevations measured on June 11, 1982.
Δ Difference from previous level survey, in metres.
Δ' Difference from original (1979 - 1980) levels, in metres.

Note: Levels for 1980 and 1981 are not included in this table.
They are presented in Research Report No 84-07-K.

TABLE III

ASH CELL GROUNDWATER QUALITY STUDIES - 1983
THUNDER BAY TGS EXTENSION

RELATIVE PIEZOMETER AND LAKE WATER LEVELS - 1983
(Relative to Average Shoreline Level of 182.88 m)

Piezometer Identification	Relative Water Levels in Piezometers (m)				
	Dates Measurements Taken				
	May 4, 1983	June 24, 1983	Aug. 10, 1983	Sept 28, 1983	Oct 28, 1983
P78 1A	1.26	1.06	0.90	0.69	1.15
P78 1B	1.12	1.16	1.08	0.73	1.29
P78 2A	1.42	1.27	1.22	1.02	1.32
P78 2B	1.44	1.29	1.20	1.03	1.33
P78 3A	1.46	1.27	1.16	0.96	1.31
P78 3B	1.46	1.24	1.21	0.96	1.31
P78 4A	1.26	1.24	1.14	1.08	1.28
P78 4B	1.17	1.20	1.11	1.01	1.23
P78 4C	1.40	1.23	1.14	1.07	1.25
P78 5A	0.97	1.22	1.28	1.02	1.19
P78 5B	1.29	1.15	1.04	0.94	1.13
P78 6A	1.19	1.11	1.05	0.89	1.07
P78 6B	1.24	1.13	1.06	0.90	1.08
P78 7A	0.94	1.05	0.97	0.87	1.01
P78 7B	1.25	1.13	1.08	0.96	1.09
P78 8A	0.80	1.10	1.03	0.90	1.05
P78 8B	1.24	1.13	1.09	0.92	1.09
P78 9A	0.79	0.89	0.86	0.80	0.87
P78 9B	0.66	0.85	0.79	0.76	0.82
P78 10A	1.17	1.07	0.97	0.92	1.04
P78 10B	1.13	1.03	0.94	0.89	1.01
P78 11A	1.15	1.05	0.97	0.89	1.00
P78 11B	1.13	1.04	0.97	0.89	1.03
P78 12A	1.00	1.02	0.86	0.90	--
P78 12B	0.88	1.08	0.96	0.96	--
P78 13A	0.87	1.05	0.98	0.92	1.02
P78 13B	0.79	1.06	1.00	0.92	1.03
P78 14A	-	-	-	--	--
P78 14B	-	-	-	--	--
P78 15A	1.09	1.05	0.99	0.86	1.06
P78 15B	1.29	1.05	1.06	0.87	1.08
P78 16A	1.05	1.12	1.03	0.86	1.11
P78 16B	1.24	1.14	1.11	0.96	1.12
P78 17A	-	-	-	--	--
P78 17B	-	-	-	--	--
P78 18A	1.31	1.17	1.14	0.59	1.16
P78 18B	1.34	1.19	0.95	0.66	1.20
P78 19A	1.36	1.05	1.01	0.42	1.12
P78 19B	1.33	1.03	1.00	0.54	1.10
P78 20A	1.44	1.33	1.20	0.87	1.26
P78 20B	1.25	1.33	1.16	0.88	1.28
P79 21A	1.25	1.10	1.17	0.33	1.10
P79 21B	1.25	1.14	1.10	0.34	1.00
P80 22A	1.21	1.38	1.24	0.99	1.39
P80 22B	1.64	1.39	1.30	0.98	1.39
Lake Levels (1)	0.25	0.34	0.36	0.34	0.38

(1) Marine Environmental Data, Services Branch, Fisheries and Oceans, Ottawa. See Table IV for detailed data.

DAILY MEAN LEVELS MOYENNES JOURNALIERES DE NIVEAU D EAU

STATION 10050 THUNDER BAY BAY

TIME ZONE EST

DAY	MONTH	YEAR	MONTHLY MEANS	DAILY MEANS										HIGH INSTANTANEOUS			LOW INSTANTANEOUS		
														DAY	TIME	HT	DAY	TIME	HT
1	10	1	83	(0.29)*	18320	18319	18321	18323	18319	18321	18317	18323	18326	18320					
11	20	1	83		18319	18320	18317	18317	18317	18319	18314	18315	18318	18318					
21	31	1	83	183172	18317	18316	18315	18313	18312	18312	18314	18317	18316	18312	18313	4	730	18333	26	2230	18307
1	10	2	83	(0.23)	18315	18310	18308	18312	18311	18311	18313	18311	18312	18314							
11	20	2	83		18314	18313	18314	18311	18311	18312	18309	18310	18312	18310							
21	28	2	83	183110	18310	18311	18309	18307	18306	18311	18310	18307				13	1115	18320	3	215	18300
1	10	3	83	(0.20)	18307	18308	18306	18309	18305	18309	18311	18309	18305	18308							
11	20	3	83		18310	18312	18311	18308	18309	18310	18309	18307	18305	18307							
21	31	3	83	183083	18307	18307	18307	18308	18309	18309	18306	18306	18308	18309	18309	6	1845	18318	9	200	18300
1	10	4	83	(0.21)	18307	18305	18309	18305	18306	18306	18305	18307	18306	18306							
11	20	4	83		18306	18307	18309	18307	18310	18310	18310	18310	18311	18311							
21	30	4	83	183047	18310	18310	18310	18311	18312	18312	18312	18312	18312	18312		26	1815	18323	14	915	18294
1	10	5	83	(0.25)	18312	18310	18313	18311	18314	18312	18310	18312	18312	18313							
11	20	5	83		18313	18313	18316	18311	18311	18313	18314	18314	18312	18312							
21	31	5	83	183131	18314	18313	18313	18315	18313	18314	18315	18315	18314	18315	18318	30	1845	18322	2	645	18301
1	10	6	83	(0.34)	18319	18320	18320	18320	18321	18321	18322	18322	18322	18322							
11	20	6	83		18324	18323	18323	18324	18324	18324	18323	18322	18322	18323							
21	30	6	83	183224	18323	18325	18323	18322	18325	18321	18321	18322	18322	18326		22	1845	18338	26	2000	18311
1	10	7	83	(0.38)	18329	18328	18326	18329	18326	18328	18329	18327	18327	18328							
11	20	7	83		18329	18328	18326	18328	18327	18327	18327	18327	18326	18326							
21	31	7	83	183262	18325	18327	18325	18324	18325	18325	18326	18326	18324	18324	18325	4	730	18350	3	2315	18288
1	10	8	83	(0.36)	18323	18324	18325	18325	18326	18324	18326	18322	18324	18326							
11	20	8	83		18325	18326	18326	18324	18325	18324	18324	18325	18325	18323							
21	31	8	83	183243	18325	18323	18329	18324	18325	18324	18324	18324	18324	18323	18323	19	1445	18340	19	1315	18310
1	10	9	83	(0.34)	18324	18324	18324	18323	18323	18322	18322	18324	18323	18323							
11	20	9	83		18323	18322	18322	18322	18323	18322	18325	18324	18322	18321							
21	30	9	83	183221	18320	18316	18320	18322	18320	18320	18320	18322	18320	18321		10	1315	18349	20	630	18306
1	10	10	83	(0.38)	18323	18319	18321	18323	18323	18319	18321	18322	18323	18325							
11	20	10	83		18329	18322	18323	18323	18331	18331	18328	18328	18330	18329							
21	31	10	83	183256	18329	18324	18326	18330	18327	18328	18330	18323	18327	18328	18328	16	245	18341	3	530	18303
1	10	11	83	(0.35)	18326	18320	18321	18322	18325	18323	18325	18321	18321	18321							
11	20	11	83		18321	18322	18324	18322	18320	18319	18320	18322	18322	18327							
21	30	11	83	183226	18321	18326	18331	18324	18323	18322	18326	18324	18322	18322		23	2315	18352	2	1945	18312
1	10	12	83	(0.29)	18323	18321	18325	18321	18319	18319	18322	18318	18319	18319							
11	20	12	83		18325	18314	18320	18314	18315	18317	18316	18315	18316	18316							
21	31	12	83	183174	18321	18315	18316	18320	18313	18315	18316	18312	18314	18316	18313	4	215	18330	24	1100	18309

JOUR	MOIS	MOYENNES	MOYENNES JOURNALIERES	JOUR	TEMPS	HT	JOUR	TEMPS	HT

* Lake water levels - the difference between the monthly means & the average shoreline level of 182.88 m

LAKE SUPERIOR WATER LEVELS - 1983

THUNDER BAY HARBOUR - STATION 10050

(Marine Environmental Data, Services Branch, Fisheries & Oceans, Ottawa)

TABLE IV

3. Groundwater Characteristics

The analytical results obtained at Thunder Bay TGS and at Research on groundwater samples taken on May 6 and August 11, 1983, are shown in Appendix A. The pH, alkalinity and conductivity data obtained at Thunder Bay TGS are also included in the summary. However, because they were obtained on the same samples that were submitted for the comprehensive analysis, the results are shown under a different date (one day after the actual sampling) to avoid computer problems in recalling the data in the future. The main groundwater characteristics are presented in Tables V to XI, and Figures 3 to 10, in the discussion section.

DISCUSSION

1. Piezometer Reference Levels

The piezometer reference levels for 1983, given in Table II, show that from November 3, 1982 to May 18, 1983, relatively small changes occurred in most piezometer levels. Most of the changes were small increases in elevations. The biggest increases were 6 cm in piezometers 21B and 5A, and 5 cm in piezometers 1A, 5B and 19A. The remaining changes were of smaller magnitude, five of which were slight (<2 cm) decreases.

Comparison of the 1983 elevations with the original (1978-80) levels shows that in most cases the piezometer levels rose. The greatest increases (between 11 and 16 cm) occurred with piezometers 5A, 5B, 7B, 20B, 21A and 22B. These piezometers are on the south side and on the northwest corner of the ash cell. The greatest decrease in elevations occurred with piezometer 22A which decreased by 16 cm. It is not known why the changes in elevations of piezometers 22A and 22B are large decreases and increases respectively. It is possible that the values given for the original 1980 levels were reversed.

The greatest changes in piezometer elevations, increases and decreases, seem to involve piezometers located on the southwest and the northwest corners of the cell. This suggests the presence of some possible peculiarities in those areas causing significant heaving and settling of the ground.

2. Groundwater Levels

The piezometer water level data acquired in 1983 (Table III) show that groundwater levels in the ash cell area varied from a low of 0.33 m above the average shoreline level of 182.88 m (reference level), in piezometer 21A on September 29, 1983, to a high of 1.64 m above the average shoreline level, in piezometer 22B on May 4, 1983. Other high levels occurred in piezometers 2A, 2B, 3A, 3B, 4A, 4B, 4C and 18A to 22A.

The relationships between groundwater levels in several selected piezometers, lake water levels and total weekly precipitation, presented in Figure 2, show that generally groundwater levels were highest at the start of the survey in May and gradually decreased to their lows in September and then rose in October. The 1982 groundwater levels were also at about these levels but were more stable. During the period when groundwater levels were highest, the lake water was at its low level. The gradual increase in the lake water levels from April to its peak in July and August was accompanied by a decrease in groundwater levels. The plot of total precipitation data shows generally uniform precipitation conditions from March to October thus indicating no significant effects on groundwater levels. As observed in the previous years, the 1983 groundwater level data show again that changes in groundwater levels are seasonal and not affected by changes in lake water levels.

3. Groundwater Quality

The data on the chemical characteristics of the groundwaters sampled in 1983 are summarized in Appendix A. The major ion chemistry of the waters, illustrated by Piper plots and summarized by ion balances, is given in Appendix B. The main chemical characteristics of the groundwaters from locations surrounding the ash cell are discussed below.

(a) pH Levels

A summary of the 1983 pH levels in the groundwaters from the ash storage area is shown in Table V. Figure 3 shows a plot of pH levels in waters from six selected piezometers, from 1978 through 1983.

During 1983, the pH levels of the groundwaters examined at Research, ranged from a low of 6.2, from piezometer 16A on May 6, to a high of 8.1, from piezometer 18B, on May 6. The remaining pH levels were between these two and are essentially the same for both sampling dates. The pH levels obtained in the field are essentially the same. They range between 6.3 and 7.4. The 1983 pH levels resemble those obtained during the previous years' surveys and those commonly associated with natural surface or well waters.

The summary plot in Figure 3 shows no significant changes in pH levels of the groundwaters sampled since 1978.

(b) Alkalinity

A summary of the 1983 bicarbonate alkalinity (HCO_3 as $CaCO_3$) data on the groundwaters from the ash area is shown in Table VI. Figure 4 shows a plot of alkalinity levels of waters from six selected piezometers from 1978 through 1983.

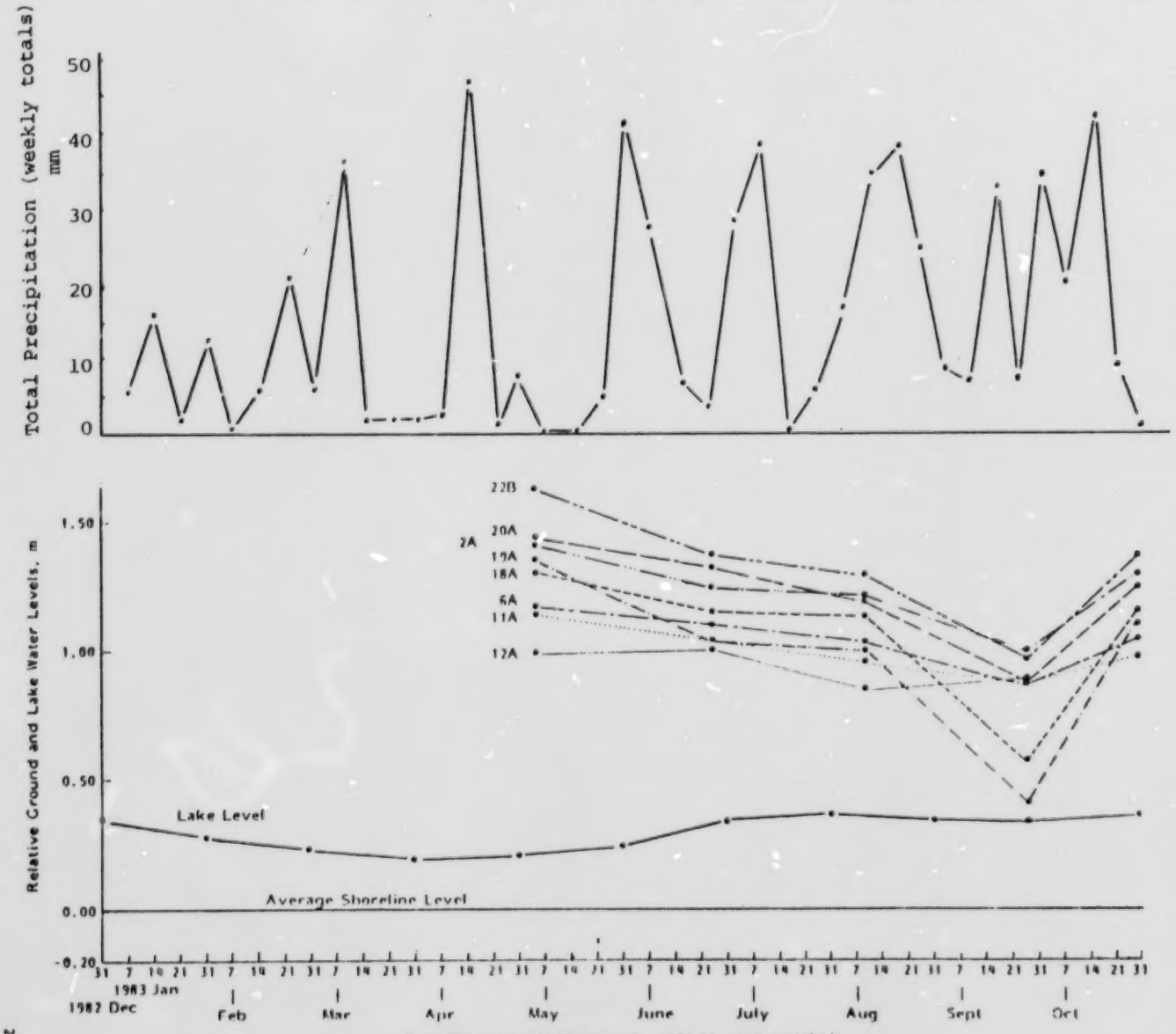


FIGURE 2

ASH CELL STORAGE AREA GROUND AND LAKE WATER LEVELS* - 1983

*(In m and relative to the average shoreline level of 182.88 m)

and Precipitation (mm)

TABLE V

ASH CELL AREA GROUNDWATER QUALITY
TBTGS - 1983

TEST: pH

Location	Sampling Date 830506	830507*	830811	830812*
01A	6.8	6.5	7.0	6.8
01B	6.8	6.6	7.4	6.8
02A	6.6	6.8	7.0	6.7
02B	7.5	7.0	7.5	6.8
03A	6.6	7.0	7.0	6.8
03B	7.2	7.1	7.2	7.0
04A	6.8	7.2	6.9	6.9
04B	6.9	7.0	7.0	6.7
04C	6.4	7.0	6.9	6.8
05A	6.3	7.0	6.8	6.7
05B	6.2	7.1	7.0	6.5
06A	6.4	7.0	7.3	6.7
06B	6.7	7.0	6.7	6.7
07A	6.7	7.3	6.6	6.6
07B	6.5	7.1	6.7	6.6
08A	6.4	6.8	6.6	6.7
08B	6.9	6.9	7.3	6.7
09A	6.8	6.5	6.6	6.6
09B	6.4	7.8	7.6	6.5
10A	6.7	7.0	6.8	6.6
10B	6.8	7.1	7.0	6.7
11A	6.7	6.8	6.8	6.6
11B	6.6	6.6	7.3	6.7
12A	6.8	7.0	7.0	6.7
12B	6.8	7.0	7.2	6.6
13A	6.3	6.9	6.9	6.5
13B	7.6	6.6	7.2	6.3
15A	6.4	6.9	6.6	6.6
15B	6.8	6.9	7.1	6.5
16A	6.2	7.0	6.3	6.5
16B	6.8	7.0	7.3	6.4
18A	6.7	7.1	7.1	6.7
18B	8.1	7.2	-	6.9
19A	7.0	6.6	7.1	6.8
19B	7.2	6.9	-	6.8
20A	7.9	7.2	7.0	6.6
20B	6.8	7.1	6.9	6.6
21A	6.9	6.5	6.9	6.6
21B	7.2	6.9	7.6	6.4
22A	7.4	7.4	7.1	6.9
22B	7.4	7.2	6.8	6.5

*TBTGS data obtained on fresh samples taken on the day before that shown. This is to avoid confusion in data input to computer (see page 11).

ASH CELL GROUNDWATER--TBTGS--1983

Fig. 3 PH(LAB) vs TIME

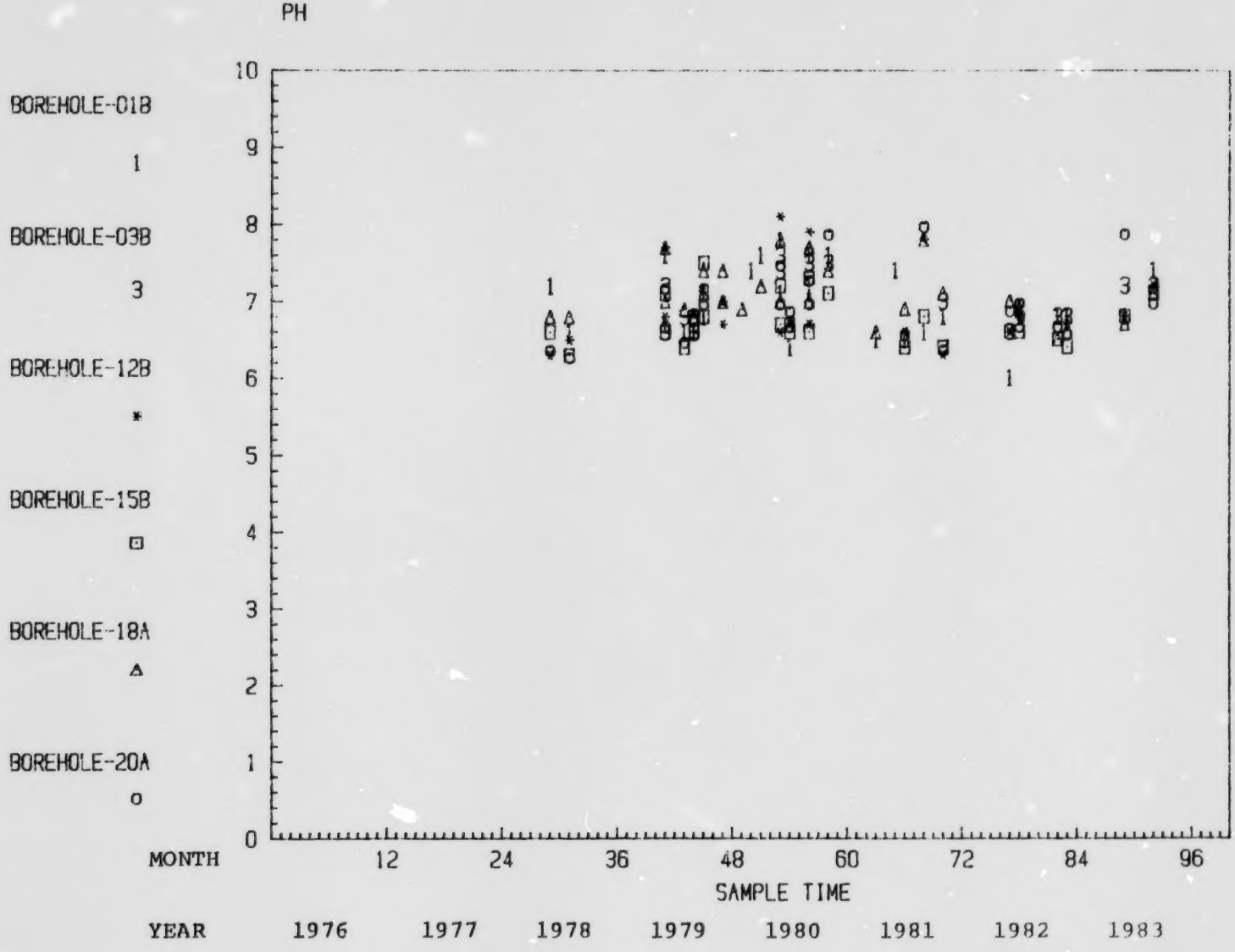


TABLE VI

ASH CELL AREA GROUNDWATER QUALITY
TBTGS - 1983

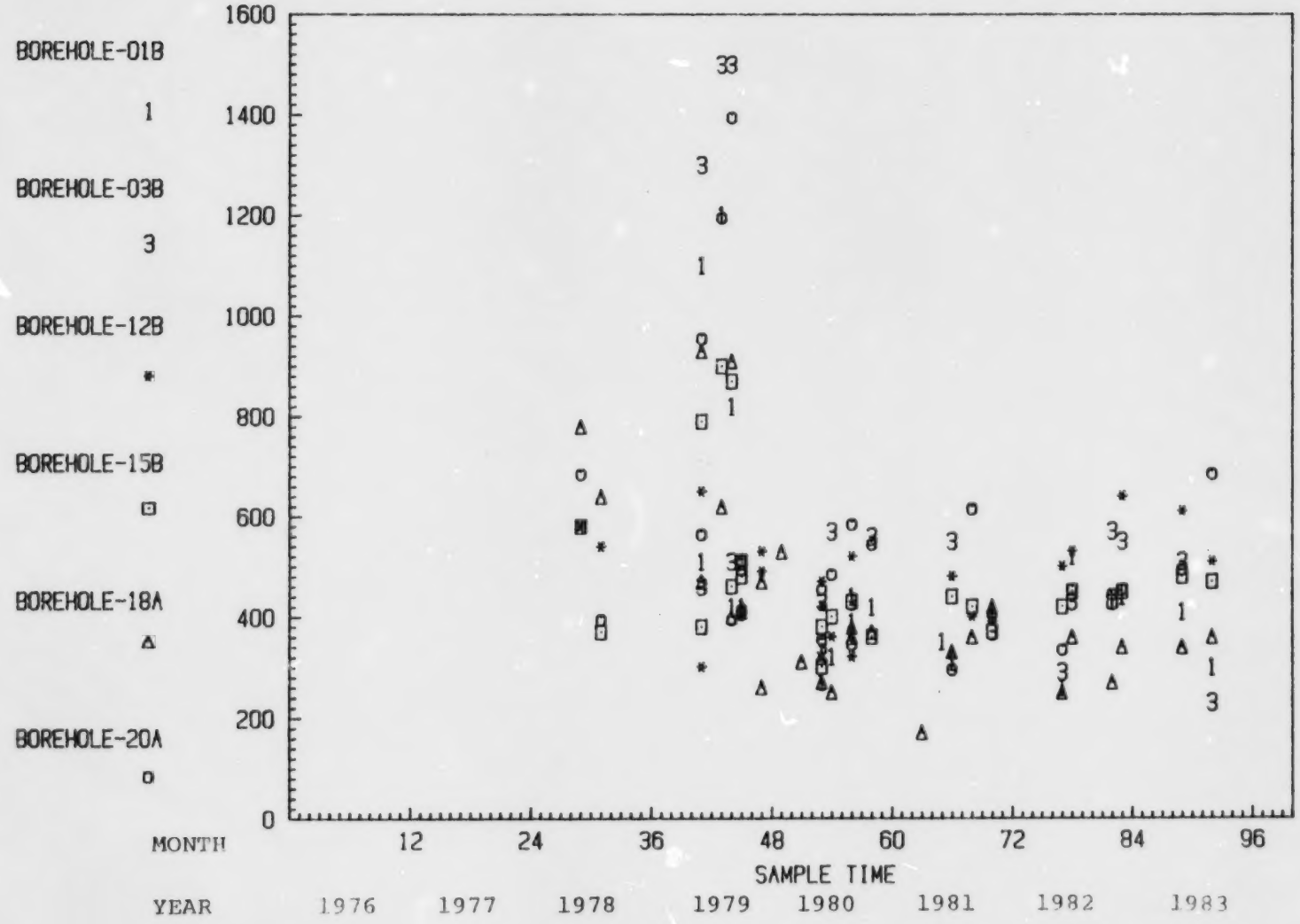
TEST: ALK HCO_3 mg/L as $CaCC_3$

Location	Sampling Date 830506	830507*	830811	830812*
01A	640	640	550	640
01B	410	440	300	330
02A	360	420	420	460
02B	430	450	500	570
03A	470	490	490	550
03B	510	530	230	330
04A	320	340	360	400
04B	590	610	480	550
04C	450	520	460	550
05A	360	440	360	410
05B	230	290	230	260
06A	610	690	610	670
06B	710	800	650	760
07A	330	350	350	420
07B	330	390	420	440
08A	380	550	470	730
08B	460	480	580	660
09A	280	310	270	330
09B	510	290	240	290
10A	370	390	430	470
10B	450	460	470	490
11A	460	490	510	590
11B	600	620	720	740
12A	550	580	580	640
12B	610	630	510	570
13A	280	330	280	330
13B	240	250	220	360
15A	320	350	300	390
15B	480	500	470	330
16A	160	220	210	340
16B	210	230	220	310
18A	340	350	360	400
18B	390	400	-	-
19A	260	220	160	190
19B	93	90	-	-
20A	500	510	690	740
20B	350	350	400	470
21A	160	200	190	190
21B	140	160	100	160
22A	510	520	510	530
22B	490	510	480	480

*TBTGS data obtained on fresh samples taken on the day before that shown. This is tc avoid confusion in data input to computer.

ASH CELL GROUNDWATER--TBTGS--1983

Fig. 4 ALKALINITY (LAB) vs TIME



The 1983 alkalinity levels of the groundwaters examined at Research varied somewhat. They ranged from lows of about 90 mg/L as $CaCO_3$, in the May sample from piezometer 19B, to a high of about 710 mg/L in the May sample from piezometer 6B. In general, low (<200 mg/L) alkalinity levels were present, on at least one occasion, in waters from piezometers 16A, 19A, 21A and 21B. These piezometers are all located on the north side of the ash cell. High (>500 mg/L) alkalinity levels were present in waters from piezometers 1A, 2B, 3B, 4B, 4C, 6A, 6B, 9B, 11A, 12A, 12B, 20A, 22A and 22B. With the exception of piezometers 12A and 12B all other piezometers are located close to and around the entire ash cell.

As observed in 1982 (Research Report 84-67-K), the alkalinity values obtained at TBTGS on fresh water samples are somewhat higher than those obtained at Research. This is probably due to normal changes in the chemical equilibrium of the water caused by changes in the water's temperature, dissolved gases and other chemical reactions. In addition, more of the waters sampled in August (warmer month) had higher alkalinities than those sampled in June. This supports the speculation/3/ that enhanced microbiological activity during the warmer months could produce waters of higher alkalinities.

With the exception of the high alkalinities observed in waters sampled in 1979 (Figure 4) the alkalinity levels during the rest of the study period, 1978 and 1980 to 1983, were relatively stable. The high 1979 alkalinity levels coincide with the start of placement of wet (leached) bottom ash and fly ash from Unit #1. These high values dropped suddenly in the latter part of 1979 and remained stable ever since. As the high alkalinity levels in the first half of 1979 were sudden and of short duration, it suggests an occurrence of an unusual event, such as some ground disturbance, having a temporary effect on water quality.

(c) Sulphate Levels

A summary of the 1983 data on sulphate levels in the groundwaters examined is shown in Table VII. Figure 5 shows a plot of SO_4 levels in waters from six selected piezometers from 1978 through 1983.

Waters from most locations had relatively low (<50 mg/L) sulphate levels. The lowest levels were present in waters from piezometers located mainly along the south and east sides, and on the northeast and southwest corners of the ash cell where least amount of ash has been placed.

High (>100 mg/L) sulphate levels were found in groundwaters from piezometers 1B, 3B, 10A, 16A, 16B and 22B, all located close to and on the north, east, and west sides of the ash cell where most ash is piled. The somewhat higher sulphate concentrations present in the August samples and lower in the May samples could be influenced by

TABLE VII

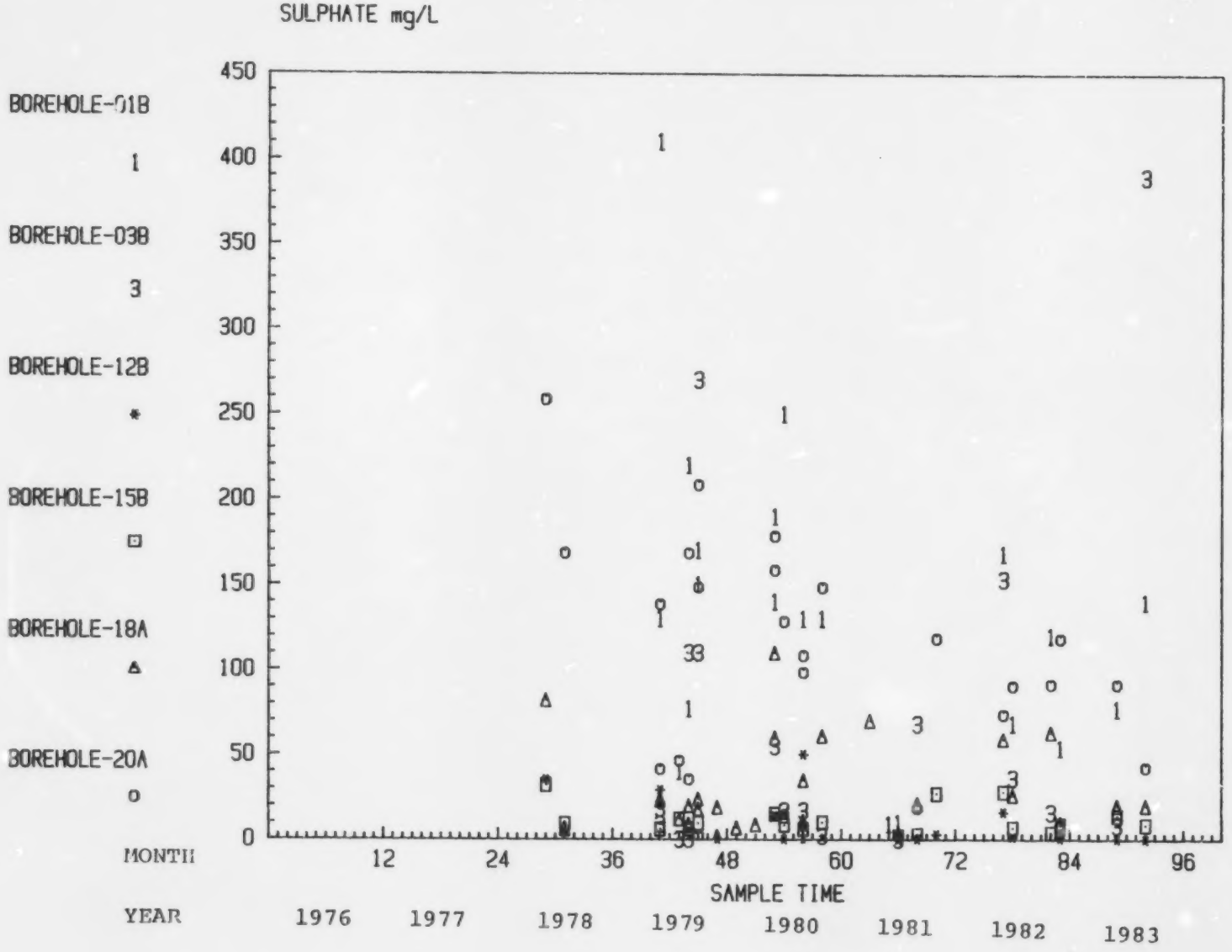
ASH CELL AREA GROUNDWATER QUALITY
TBTGS - 1983

TEST: SO_4 mg/L

Location	Sampling Date 830506	830811
01A	54	76
01B	77	140
02A	47	42
02B	13	9
03A	11	4.2
03B	8.2	390
04A	1.3	0.9
04B	1.5	40
04C	6.6	3.4
05A	11	6.4
05B	75	77
06A	2.1	<0.5
06B	2.6	7.2
07A	1.0	<0.5
07B	1.4	<0.5
08A	0.2	<0.5
08B	14	0.8
09A	0.4	1.5
09B	0.6	1.3
10A	0.4	110
10B	0.2	83
11A	0.2	3.5
11B	2.9	<0.5
12A	0.6	<0.5
12B	0.2	<0.5
13A	14	6.0
13B	13	4.1
15A	5.4	32
15B	14	8.5
16A	290	240
16B	310	320
18A	20	20
18B	4.3	-
19A	37	12
19B	29	-
20A	93	44
20B	66	90
21A	14	20
21B	5.3	9
22A	36	29
22B	100	83

ASH CELL GROUNDWATER-TBTGS-1983

Fig. 5 SULPHATE vs TIME



the lower groundwater levels existing in August and higher in May. The variations in SO_4 levels in waters from the same piezometers, such as 03B, 10A, 10B, but sampled on different dates could also have been caused by changing water flow patterns or by some changes in soil and biological conditions at that time of the year in those specific locations.

Comparison of the SO_4 concentrations in groundwaters from some selected piezometers from 1978 through 1983, as shown in Figure 5, shows that SO_4 concentrations also varied substantially during the previous years. These variations occur between and within the piezometers sampled. As is evident in Figure 5, the most extreme variations occurred in waters from piezometers 01B, 03B and 20A, all located at the northwest corner of the ash cell where most of the ash is stored. Because of these wide variations in SO_4 concentrations definite trends and correlations between SO_4 levels, sampling dates, locations, water levels and other site characteristics are not evident at this time.

(d) Sodium Levels

A summary of the 1983 data on sodium levels in the groundwaters examined is shown in Table VIII. Figure 6 shows a summary of Na levels in waters from six selected piezometers from 1978 through 1983.

During 1983 sodium levels were present in a narrow range. They ranged from a low of 6.3 mg/L in May, in water from piezometer 3B located on the west side of the ash cell, to a high of 43 mg/L in August, in water from piezometer 20A located on the northwest corner of the pile. Most waters sampled in August had higher Na levels than did the May samples. This could be due to lower groundwater levels existing in August than in May.

As observed in 1982, high (>30 mg/L) sodium levels are present in waters from the north and northwest corner of the ash cell (piezometers 19A, 20A, 22A and 22B), where most ash has been deposited, and in waters from piezometers 8B and 10B close to the new road constructed of bottom ash. Somewhat lower sodium levels (>20 mg/L) were also observed in waters from piezometers 1A, 3A, 3B, 4A, 4B, 6A, 6B, 8B, 10A, 11A, 12A, 12B, 16A and 18A. These piezometers are located along the entire perimeter of the ash cell. Some of these piezometers are located some distance away from the stockpiled ash where less leachate is expected to be present.

Although the 1983 data show some high Na levels, particularly from the northwest corner of the ash cell, higher Na levels existed in groundwaters sampled in 1979-80-81 and 1982, as shown in Figure 6. During 1980 Na levels as high as 140 mg/L were present. The pattern of Na levels in Figure 6 shows a continuing decrease in Na levels from the 1980 highs with the 1983 levels being close to those present in 1978.

TABLE VIII

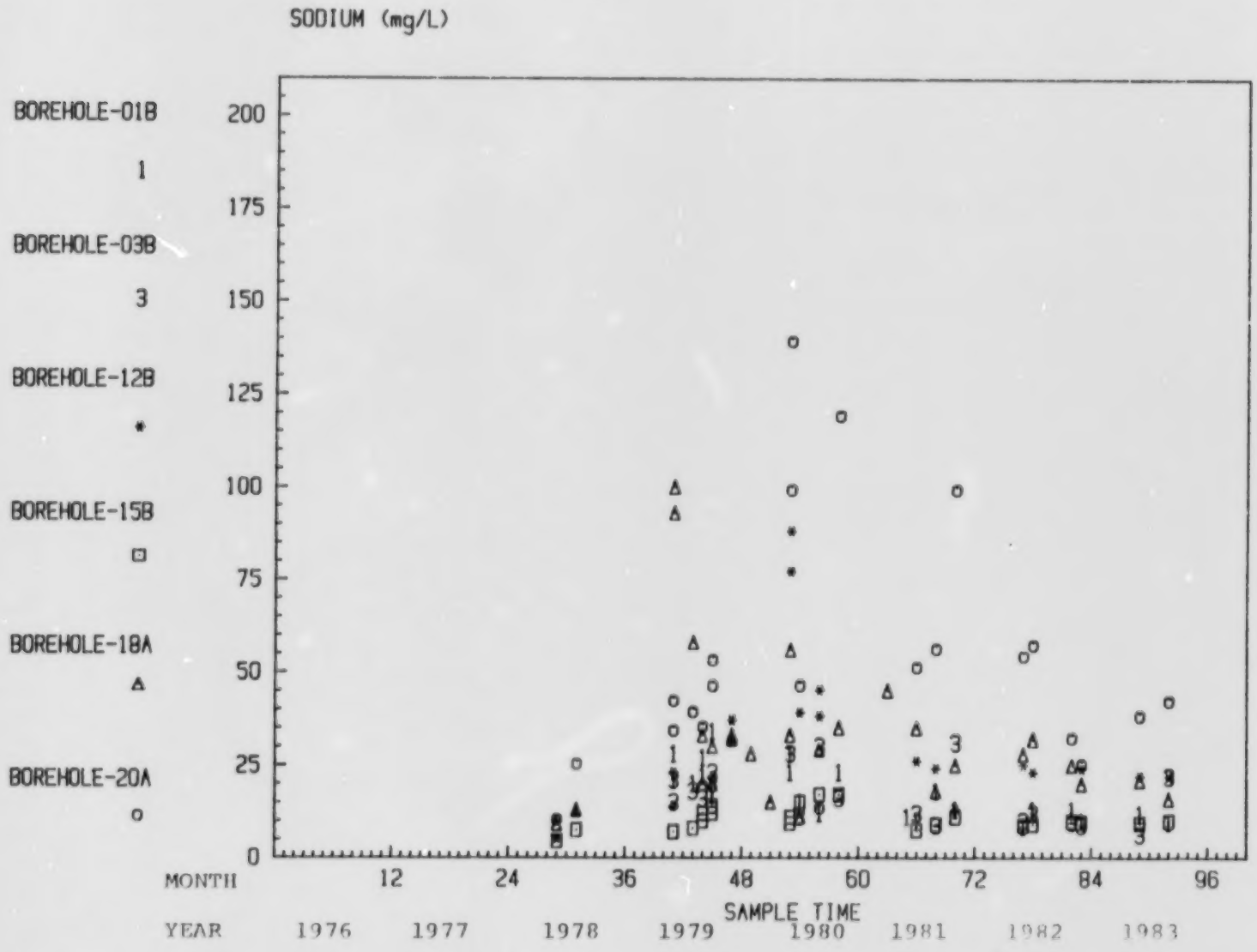
ASH CELL AREA GROUNDWATER QUALITY
TBTGS - 1983

TEST: Na mg/L

Location	Sampling Date 830506	830811
01A	21	22
01B	12	9.7
02A	8.4	12
02B	7.1	14
03A	14	20
03B	6.3	22
04A	16	20
04B	25	26
04C	13	16
05A	14	16
05B	9.2	12
06A	26	27
06B	19	21
07A	14	16
07B	10	14
08A	9.1	10
08B	20	30
09A	10	12
09B	14	11
10A	14	25
10B	22	40
11A	18	24
11B	14	15
12A	16	26
12B	22	22
13A	8.4	9.1
13B	10	11
15A	17	12
15B	9.4	10
16A	-	20
16B	12	14
18A	21	16
18B	9.9	10
19A	35	6.4
19B	14	8.6
20A	39	43
20B	12	17
21A	7.5	9.0
21B	16	12
22A	38	37
22B	33	17

ASH CELL GROUNDWATER-TBTGS-1983

Fig. 6 SODIUM vs TIME



Although the high Na levels present in the waters sampled in 1979 and 1980 coincide with the start of ash placement in mid 1979, and would therefore appear to be the result of ash placement, it is difficult to explain why the increase in Na levels was so sudden and extreme. The ash placed in 1979 was already partially leached, as it was initially held for some time as a slurry in a lagoon before its transfer to the ash storage cell. Another incongruous effect apparent is the gradual reduction in Na levels from the 1980 highs as more ash was placed in the ash cell. Perhaps percolation of moisture through the ash pile has been hindered by compaction and surface run-off increased, thus limiting the amount of Na leached from the ash pile, or there have been major changes in waterflow rates or patterns reducing the Na levels in the groundwater.

(e) Magnesium Levels

A summary of the 1983 magnesium levels in the groundwaters examined is shown in Table IX. Figure 7 shows a summary of Mg levels in waters from six selected piezometers, from 1978 through 1983.

The 1983 magnesium levels were present in a narrow range. They range from a low of about 10 mg/L in water from piezometer 21B, located on the north side of the ash cell, to a high of 77 mg/L in May in water from piezometer 6B located on the south side of the cell. There is no significant overall difference in Mg levels in the waters sampled on different dates.

Low (<20 mg/L) magnesium levels were present in waters from piezometer nests 19 and 21 on the north side and some distance away from the ash cell. The highest (>50 mg/L) magnesium levels were present in waters from piezometer nests 1, 6,8,10,11,12,20 and 22. With the exception of piezometer 12 the rest of the piezometers are close to and around the entire perimeter of the ash cell.

As observed in 1982, waters from piezometers 12A and 12B, although located somewhat away from the cell, on the east side, again had comparatively high magnesium levels. No reason for this can be given at this time.

As shown in Figure 7, the 1983 Mg levels in waters from a few selected piezometers are somewhat higher than they were in 1982, 1981 and 1980. This suggests progressive increase in Mg levels in the groundwater from 1980 and 1981. However, during 1978 and 1979 some waters also contained significantly higher Mg levels. The 1978 and 1979 Mg levels could be regarded as representing normal natural groundwater quality in the area.

Although Figure 7 shows a trend of increasing Mg levels in the groundwaters from 1981 through 1983, caution should be exercised in interpreting this. Magnesium levels can be affected by the groundwater's pH and alkalinity, causing either an increase in Mg levels when the

TABLE IX

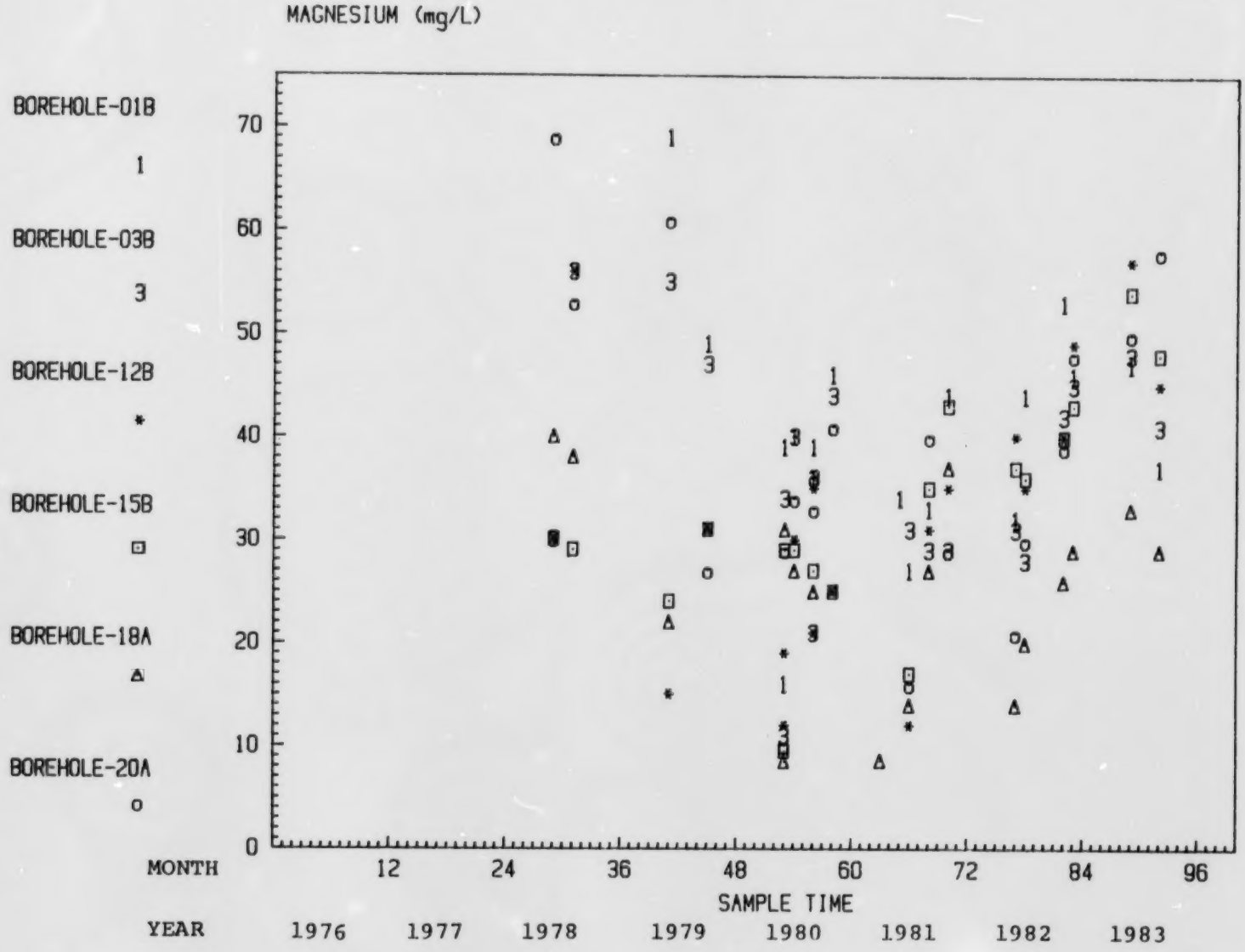
ASH CELL AREA GROUNDWATER QUALITY
TBTGS - 1983

TEST: Mg mg/L

Location	Sampling Date 830506	830811
01A	64	55
01B	47	37
02A	40	43
02B	29	33
03A	41	39
03B	48	41
04A	28	28
04B	49	35
04C	40	39
05A	35	33
05B	27	29
06A	55	55
06B	77	68
07A	30	31
07B	35	41
08A	37	44
08B	46	63
09A	28	28
09B	26	22
10A	38	56
10B	48	56
11A	48	51
11B	70	79
12A	56	55
12B	57	45
13A	30	28
13B	30	33
15A	35	31
15B	54	48
16A	-	35
16B	35	37
18A	33	29
18B	30	35
19A	18	11
19B	12	15
20A	50	58
20B	36	39
21A	17	19
21B	10	9
22A	46	44
22B	51	54

ASH CELL GROUNDWATER-TBTGS-1983

Fig. 7 MAGNESIUM vs TIME



pH and alkalinity are low and a decrease, by precipitation, when the pH and alkalinity are high. During this three year period the alkalinity levels (Figure 4) were somewhat lower than in the previous years. This could be a main contributing factor and could account for the wide variations and changes in the Mg levels over the years.

(f) Boron and Strontium Levels

Summaries of the 1983 data on the boron and strontium levels in the groundwaters examined are shown in Tables X and XI. Figures 8 and 9 show a summary of B and Sr levels respectively in waters from six selected piezometers from 1978 through 1983.

Boron levels in 1983 ranged from their detection limit of 0.02 mg/L, in waters from piezometers 5B, 9A and 19B furthest away from the ash, to a high of 0.95 mg/L in waters from piezometers 15B and 16A at the northeast corner of the pile where fresh ash has been placed. It is observed, however, that relatively higher boron levels (>0.2 mg/L) were present in the August water samples when groundwater levels were lower.

Strontium levels ranged from a low of 0.05 mg/L in piezometer 21B to a high of 0.35 mg/L in piezometer 12B in the August samples. As the test method used for the May samples had a detection limit of 5 mg/L, the results simply show that all waters had strontium levels below the 5 mg/L, therefore, these two sets of results cannot be compared.

Waters of high strontium levels (>0.2 mg/L) were from piezometer nests 1,3,6,10,11,12,18 20 and 22. Most of these locations also had high boron levels. Waters of low strontium levels (<0.1 mg/L) were from piezometer nests 2,5,9,13,19 and 21, all but 2 and 13 of which are somewhat distant from the main ash pile.

For comparison purposes, boron and strontium levels in waters from six selected locations are shown in Figures 8 and 9. It is evident that the 1983 boron levels are significantly lower than the 1982 levels and about similar to those present in the waters sampled prior to 1982. The 1983 strontium levels are lower or essentially unchanged from the previously obtained levels. The rise in the 1982 boron levels and the subsequent drop in 1983 cannot be explained at this time. Boron and strontium levels that will be obtained in 1984 might help in explaining the 1982 rise in B concentrations.

(g) Trace Metals

A cursory examination of the 1983 and previously obtained data on trace metals concentrations in the groundwaters around the ash cell does not show any apparent significant changes or trends. However, it is planned to examine these data in detail in 1984 when all the data will be stored in the computer and then will be accessible for convenient comparison and statistical analysis.

TABLE X

ASH CELL AREA GROUNDWATER QUALITY
TBTGS - 1983

TEST: B mg/L

Location	Sampling Date 830506	830811
01A	0.03	0.14
01B	0.04	0.56
02A	0.05	0.10
02B	0.15	0.31
03A	0.05	0.13
03B	0.04	0.28
04A	0.03	0.06
04B	0.06	0.20
04C	0.14	0.14
05A	0.05	0.10
05B	<0.02	0.05
06A	0.08	0.13
06B	0.11	0.16
07A	0.06	0.07
07B	0.03	0.08
08A	0.07	0.13
08B	0.16	0.37
09A	0.02	0.07
09B	0.10	0.14
10A	0.05	0.16
10B	0.07	0.14
11A	0.07	0.13
11B	0.15	0.28
12A	0.18	0.34
12B	0.21	0.36
13A	0.08	0.12
13B	0.12	0.20
15A	0.11	0.11
15B	0.95	0.21
16A	0.95	0.74
16B	0.16	0.50
18A	0.19	0.31
18B	0.32	-
19A	0.15	0.10
19B	0.02	-
20A	0.20	0.48
20B	0.16	0.25
21A	0.10	0.10
21B	0.29	0.25
22A	0.11	0.18
22B	0.19	0.28

TABLE XI

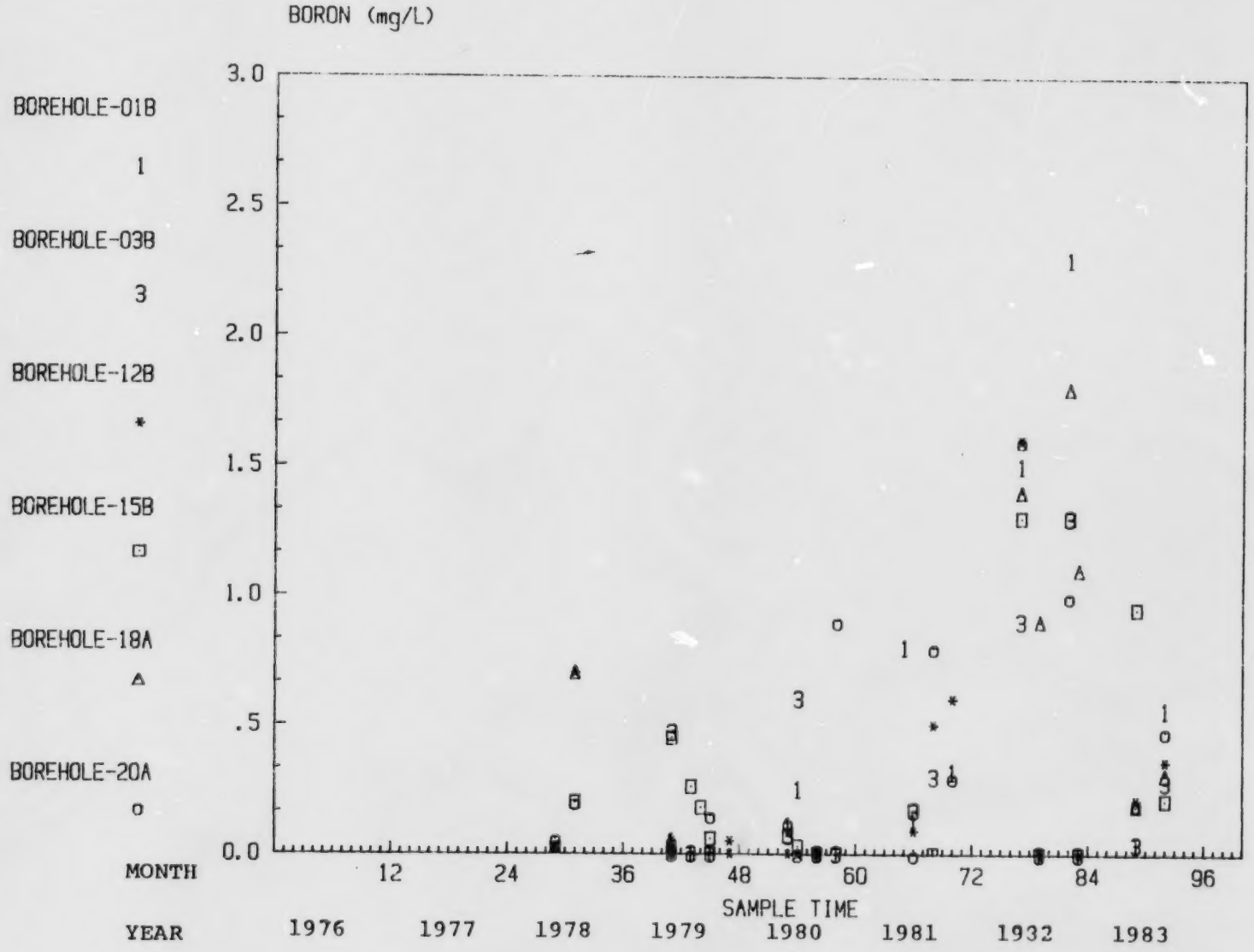
ASH CELL AREA GROUNDWATER QUALITY
TBTGS - 1983

TEST: Sr mg/L

Location	Sampling Date 830506	830811
01A	<5.0	0.23
01B	<5.0	0.14
02A	<5.0	0.10
02B	<5.0	0.18
03A	<5.0	0.18
03B	<5.0	0.24
04A	<5.0	0.12
04B	<5.0	0.18
04C	<5.0	0.16
05A	-	0.12
05B	<5.0	0.08
06A	<5.0	0.25
06B	<5.0	0.17
07A	<5.0	0.13
07B	<5.0	0.11
08A	<5.0	0.15
08B	<5.0	0.17
09A	<5.0	0.09
09B	<5.0	0.06
10A	<5.0	0.26
10B	<5.0	0.20
11A	<5.0	0.22
11B	<5.0	0.23
12A	<5.0	0.34
12B	<5.0	0.35
13A	<5.0	0.09
13B	<5.0	0.07
15A	<5.0	0.14
15B	<5.0	0.12
16A	<5.0	0.16
16B	<5.0	0.12
18A	<5.0	0.32
18B	<5.0	0.19
19A	<5.0	0.06
19B	<5.0	0.06
20A	<5.0	0.20
20B	-	0.12
21A	-	0.08
21B	-	0.05
22A	-	0.21
22B	-	0.12

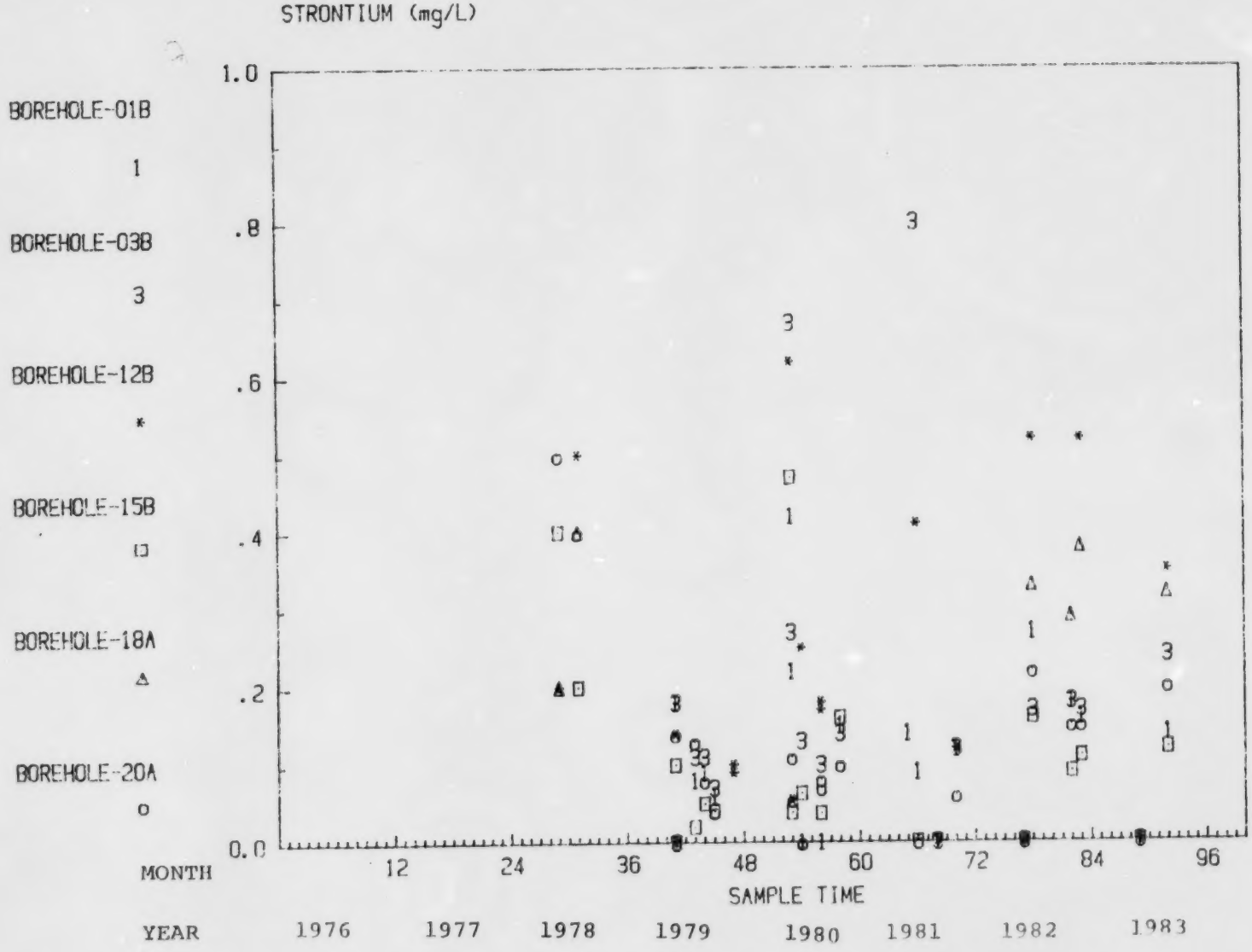
ASH CELL GROUNDWATER-TBTGS-1983

Fig. 8 BORON vs TIME



ASH CELL GROUNDWATER-TBTGS-1983

Fig. 9 STRONTIUM vs TIME



(h) Piper Plots

The 1983 data, as represented by the Piper Plots shown in Appendix B, show that the majority of the groundwaters in the vicinity of the ash storage area resemble natural surface or groundwaters. In these types of waters, the alkaline earth cations (Ca and Mg) and the weak acid anions (HCO_3 and CO_3) predominate. However, as in 1982, there is again an indication that waters from some piezometers, such as 3B, 16A and 16B, containing higher than normal SO_4 concentrations (>200 mg/L), appear to be changing. These two types of waters are represented in Figure 10.

CONCLUSIONS

As observed in the previous years, the 1983 data also show that groundwater level changes are seasonal and are not influenced by changes in lake water levels.

The 1983 data on the groundwater characteristics are essentially similar to those of the previous four years. However, changes in some groundwater characteristics have occurred at some time during the five year survey period. The following are the main changes observed.

1. Alkalinity: During 1979 there was a sharp increase in alkalinity levels from those present during 1978. In 1980 alkalinity levels dropped sharply to those of the 1978 levels and remained steady from then on through 1983.

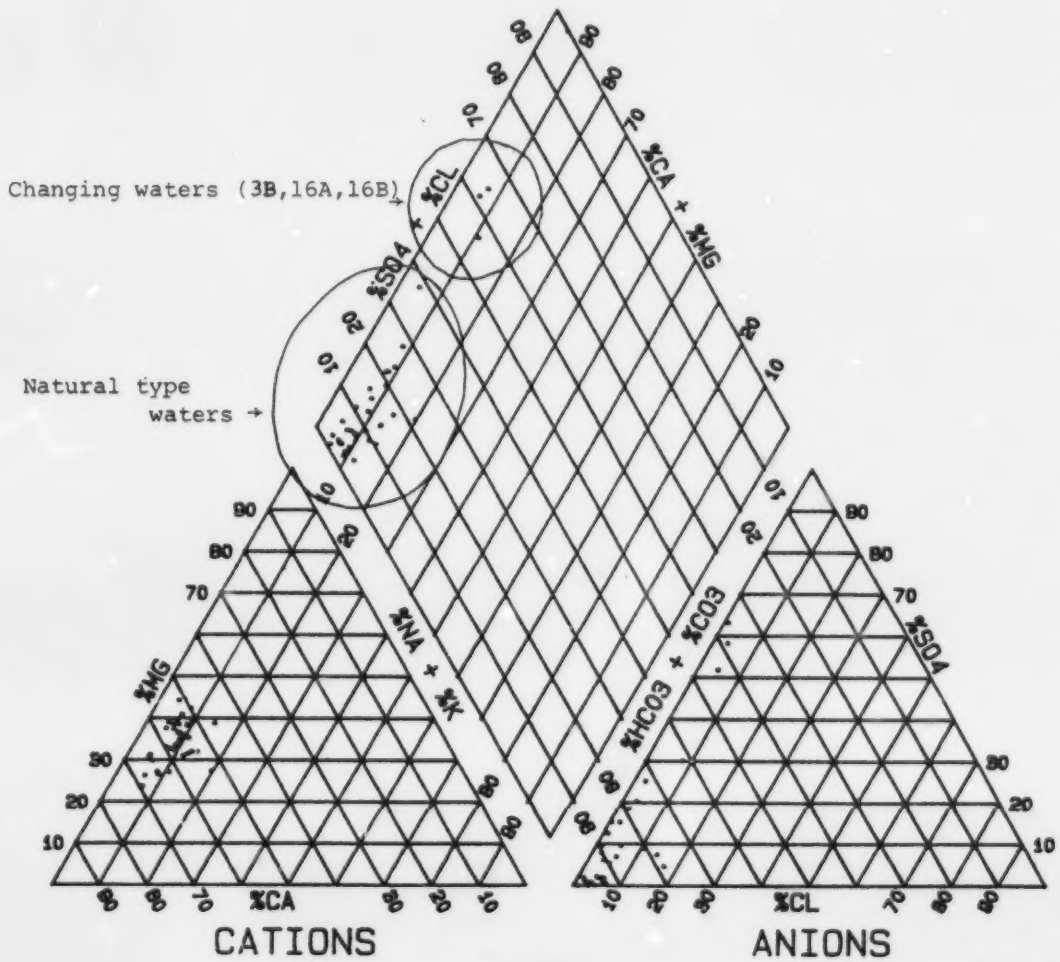
2. Sulphate: During 1983 a few very high levels (100-400 mg/L) of sulphates were observed as in 1979. The remaining levels were generally lower than during and before 1980. Most of the 1983 high levels were present in the August samples when groundwater levels were low. However, a few high levels were also present in the May samples when groundwater levels were high. Most of the high sulphate level waters are in the northwest corner of the ash cell.

3. Sodium: During 1983 most waters sampled in August, when groundwater levels were low, had higher sodium levels than the waters sampled in May when groundwater levels were high. High sodium levels were present in waters from the north, east and west sides of the ash cell. During 1983 sodium levels were generally lower than during the rest of the survey period.

4. Magnesium: There appears to be a slight increasing trend in magnesium levels from the levels in 1981 through 1982. However, higher levels of magnesium existed during 1978 and 1979.

FIGURE 10

MAJOR ION CHEMISTRY
TBTGS ASH
AUG 11 1983
TYPE - WATER
ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983



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5. Boron: Most waters sampled in August 1983, when groundwater levels were low, had higher boron levels than most of the waters sampled in May when the groundwater levels were high. The 1983 boron levels were essentially similar to those found in 1979-80-81 and substantially lower than those of 1982 when a significant increase in boron levels occurred.

6. Strontium: The 1983 strontium levels were essentially unchanged from those of the previous years.

A more detailed analysis of all data will be given in the 1984 summary report that will be prepared after data for the 1984 survey becomes available.

Approved:

D. Harrison
Manager
Chemical Research Department

Submitted:

J. Complak 8 N. DRD

J. Complak
Chemist
Environmental and Inorganic
Research Section

JC:kk:rdm

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APPENDIX A

POST-OPERATIONAL ASH CELL
GROUNDWATER QUALITY STUDIES - 1983
THUNDER BAY TGS EXTENSION

GROUNDWATER CHARACTERISTICS

(All values are in mg/L except pH and conductivity
- pH in pH units
- Conductivity in mS/m

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 61A

SAMPLING DATE

TEST	830506	830507 *	830811	830812*
AG	<.00020	--	--	--
AL	.18	--	--	--
ALKHCO3	640.	--	550.	--
ALKTOT	--	640.	--	640.
AS	<.0010	--	--	--
B	.030	--	.14	--
BA	<.10	--	--	--
BE	<.00020	--	--	--
CA	170.	--	160.	--
CD	<.00010	--	--	--
CL	31.	--	5.6	--
CO	<.0020	--	--	--
COND	120.	170.	120.	140.
CR	<.0050	--	--	--
CU	.0050	--	--	--
FE	<.050	--	--	--
HG	<.00020	--	--	--
K	1.3	--	37.	--
MG	64.	--	55.	--
MN	2.7	--	--	--
MO	<1.0	--	--	--
NA	21.	--	22.	--
NI	.0060	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.8	6.5	7.0	6.8
PO4	.28	--	--	--
SE	<.0010	--	--	--
SI	15.	--	--	--
SO4	54.	--	76.	--
SR	<5.0	--	.23	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples on the day before that shown.

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ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 01B

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	.24	--	--	--
ALKHCO3	410.	--	300.	--
ALKTOT	--	440.	--	330.
AS	<.0010	--	--	--
B	.040	--	.56	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	130.	--	130.	--
CD	<.00010	--	--	--
CL	25.	--	28.	--
CO	.0050	--	--	--
COND	90.	130.	88.	95.
CR	<.0050	--	--	--
CU	.0030	--	--	--
FE	5.4	--	--	--
HG	<.00020	--	--	--
K	1.2	--	1.9	--
MG	47.	--	37.	--
MN	2.5	--	--	--
MO	<1.0	--	--	--
NA	12.	--	9.7	--
NI	.0070	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.8	6.6	7.4	6.8
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	12.	--	--	--
SO4	77.	--	140.	--
SR	<5.0	--	.14	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

* TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 02A

TEST	830506	830507*	830611	830612*
	SAMPLING DATE			
AG	<.00020	--	--	--
AL	.24	--	--	--
ALKHCO3	360.	--	420.	--
ALKTOT	--	420.	--	460.
AS	<.0010	--	--	--
B	.050	--	.10	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	92.	--	100.	--
CD	<.00010	--	--	--
CL	3.8	--	4.9	--
CO	.0060	--	--	--
COND	69.	69.	81.	89.
CR	<.0050	--	--	--
CU	.0040	--	--	--
FE	<.050	--	--	--
HG	<.00020	--	--	--
K	.70	--	1.2	--
MG	40.	--	43.	--
MN	1.4	--	--	--
MO	<1.0	--	--	--
NA	8.4	--	12.	--
NI	.018	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.6	6.8	7.0	6.7
PO4	.061	--	--	--
SE	<.0010	--	--	--
SI	10.	--	--	--
SO4	47.	--	42.	--
SR	<5.0	--	.10	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

* TBTGS data obtained on fresh samples taken on the day before that shown.

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ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 02B

TEST	830506	830507*	830811	830812*
	SAMPLING DATE			
AG	<.00020	--	--	--
AL	.14	--	--	--
ALKHCO3	430.	--	500.	--
ALKTOT	--	450.	--	570.
AS	<.0010	--	--	--
B	.15	--	.31	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	130.	--	140.	--
CD	.00010	--	--	--
CL	7.7	--	4.9	--
CO	.011	--	--	--
COND	74.	98.	87.	95.
CR	<.0050	--	--	--
CU	.0060	--	--	--
FE	.050	--	--	--
HG	<.00020	--	--	--
K	2.0	--	2.1	--
MG	29.	--	33.	--
MN	4.7	--	--	--
MO	<1.0	--	--	--
NA	7.1	--	14.	--
NI	.018	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	7.5	7.0	7.5	6.8
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	8.7	--	--	--
SO4	13.	--	9.0	--
SR	<5.0	--	.18	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 03A

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	.23	--	--	--
ALKHCO3	470.	--	490.	--
ALKTOT	--	490.	--	550.
AS	<.0010	--	--	--
B	.050	--	.13	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	110.	--	120.	--
CD	<.00010	--	--	--
CL	6.3	--	8.5	--
CO	.0020	--	--	--
COND	83.	110.	87.	97.
CR	<.0050	--	--	--
CU	.0040	--	--	--
FE	12.	--	--	--
HG	<.00020	--	--	--
K	1.0	--	1.5	--
MG	41.	--	39.	--
MN	2.4	--	--	--
MO	<1.0	--	--	--
NA	14.	--	20.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.6	7.0	7.0	6.8
PO4	.018	--	--	--
SE	<.0010	--	--	--
SI	15.	--	--	--
SO4	11.	--	4.2	--
SR	<5.0	--	.18	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 03B

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	.16	--	--	--
ALKHCO3	510.	--	230.	--
ALKTOT	--	530.	--	330.
AS	<.0010	--	--	--
B	.040	--	.28	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	130.	--	200.	--
CD	<.00010	--	--	--
CL	5.8	--	5.1	--
CO	.0030	--	--	--
COND	85.	130.	110.	120.
CR	<.0050	--	--	--
CU	.0040	--	--	--
FE	21.	--	--	--
HG	<.00020	--	--	--
K	.53	--	2.2	--
MG	46.	--	41.	--
MN	5.5	--	--	--
MO	<1.0	--	--	--
NA	6.3	--	22.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	7.2	7.1	7.2	7.0
PO4	1.9	--	--	--
SE	<.0010	--	--	--
SI	9.0	--	--	--
SO4	8.2	--	390.	--
SR	<5.0	--	.24	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 04A

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	.14	--	--	--
ALKHCO3	320.	--	360.	--
ALKTOT	--	340.	--	400.
AS	<.0010	--	--	--
B	.030	--	.060	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	76.	--	85.	--
CD	.00010	--	--	--
CL	7.7	--	10.	--
CO	<.0020	--	--	--
COND	61.	91.	65.	77.
CR	<.0050	--	--	--
CU	.010	--	--	--
FE	7.0	--	--	--
HG	<.00020	--	--	--
K	.84	--	1.2	--
MG	28.	--	28.	--
MN	.90	--	--	--
MO	<1.0	--	--	--
NA	16.	--	20.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.8	7.2	6.9	6.9
PO4	.061	--	--	--
SE	<.0010	--	--	--
SI	20.	--	--	--
SO4	1.3	--	.90	--
SR	<5.0	--	.12	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 04B

TEST	830506	830507*	830811	830812*
			SAMPLING DATE	
AG	<.00020	--	--	--
AL	.15	--	--	--
ALKHCO3	590.	--	480.	--
ALKTOT	--	610.	--	550.
AS	<.0010	--	--	--
B	.060	--	.20	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	150.	--	130.	--
CD	.00030	--	--	--
CL	20.	--	8.2	--
CO	.019	--	--	--
COND	100.	150.	90.	100.
CR	.0080	--	--	--
CU	.014	--	--	--
FE	8.0	--	--	--
HG	.00050	--	--	--
K	.070	--	1.6	--
MG	49.	--	35.	--
MN	9.5	--	--	--
MO	<1.0	--	--	--
NA	25.	--	26.	--
NI	.012	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.9	7.0	7.0	6.7
PO4	.12	--	--	--
SE	<.0010	--	--	--
SI	9.4	--	--	--
SO4	1.5	--	40.	--
SR	<5.0	--	.18	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	.060	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 04C

TEST	SAMPLING DATE 830506	830507*	830811	830812*
AG	<.00020	--	--	--
AL	.19	--	--	--
ALKHCO3	450.	--	460.	--
ALKTOT	--	520.	--	550.
AS	.0050	--	--	--
B	.14	--	.14	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	110.	--	120.	--
CD	.00010	--	--	--
CL	7.2	--	9.0	--
CO	<.0020	--	--	--
COND	81.	130.	84.	100.
CR	.0060	--	--	--
CU	.010	--	--	--
FE	61.	--	--	--
HG	<.00020	--	--	--
K	1.0	--	1.1	--
MG	40.	--	39.	--
MN	1.5	--	--	--
MO	<1.0	--	--	--
NA	13.	--	16.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.4	7.0	6.9	6.8
PO4	.074	--	--	--
SE	<.0010	--	--	--
SI	17.	--	--	--
SO4	6.6	--	3.4	--
SR	<5.0	--	.16	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 05A

TEST	830506	830507*	830811	830812*
	SAMPLING DATE			
AG	<.00020	--	--	--
AL	--	--	--	--
ALKHCO3	360.	--	360.	--
ALKTOT	--	440.	--	410.
AS	.0020	--	--	--
B	.050	--	.10	--
BA	--	--	--	--
BE	<.00020	--	--	--
CA	92.	--	93.	--
CD	<.00010	--	--	--
CL	17.	--	16.	--
CO	--	--	--	--
COND	71.	110.	72.	68.
CR	--	--	--	--
CU	.0020	--	--	--
FE	41.	--	--	--
HG	<.00020	--	--	--
K	.92	--	1.7	--
MG	35.	--	33.	--
MN	--	--	--	--
MO	--	--	--	--
NA	14.	--	16.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.3	7.0	6.8	6.7
PO4	.080	--	--	--
SE	<.0010	--	--	--
SI	17.	--	--	--
SO4	11.	--	6.4	--
SR	--	--	.12	--
TH	--	--	--	--
TI	--	--	--	--
V	--	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 05B

TEST	SAMPLING DATE 830506	830507*	830811	830812*
AG	<.00020	--	--	--
AL	.13	--	--	--
ALKHCO3	230.	--	230.	--
ALKTOT	--	290.	--	260.
AS	<.0010	--	--	--
B	<.020	--	.050	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	70.	--	72.	--
CD	.00010	--	--	--
CL	5.5	--	5.7	--
CO	<.0020	--	--	--
COND	56.	93.	59.	79.
CR	<.0050	--	--	--
CU	.0030	--	--	--
FE	40.	--	--	--
HG	<.00020	--	--	--
K	.25	--	1.1	--
MG	27.	--	29.	--
MN	1.8	--	--	--
MO	<1.0	--	--	--
NA	9.2	--	12.	--
NI	.0070	--	--	--
NO3	1.3	--	--	--
PB	<.0020	--	--	--
PH	6.2	7.1	7.0	6.5
PO4	.28	--	--	--
SE	<.0010	--	--	--
SI	15.	--	--	--
SO4	75.	--	77.	--
SR	<5.0	--	.080	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 06A

TEST	830506	830507*	830811	830812*
			SAMPLING DATE	
AG	<.00020	--	--	--
AL	.14	--	--	--
ALKHCO3	610.	--	610.	--
ALKTOT	--	690.	--	670.
AS	.0060	--	--	--
B	.080	--	.13	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	140.	--	140.	--
CD	.00020	--	--	--
CL	15.	--	14.	--
CO	.0070	--	--	--
COND	100.	150.	110.	130.
CR	<.0050	--	--	--
CU	.0030	--	--	--
FE	56.	--	--	--
HG	<.00020	--	--	--
K	.93	--	1.1	--
MG	55.	--	55.	--
MN	4.1	--	--	--
MO	<1.0	--	--	--
NA	26.	--	27.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.4	7.0	7.3	6.7
PO4	.22	--	--	--
SE	<.0010	--	--	--
SI	17.	--	--	--
SO4	2.1	--	<.50	--
SR	<5.0	--	.25	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 06B

TEST	SAMPLING DATE 830506	830507*	830811	830812*
AG	<.00020	--	--	--
AL	.14	--	--	--
ALKHCO3	710.	--	650.	--
ALKTOT	--	800.	--	760.
AS	.0020	--	--	--
B	.11	--	.16	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	150.	--	140.	--
CD	<.00010	--	--	--
CL	6.7	--	9.2	--
CO	.0070	--	--	--
COND	120.	180.	110.	140.
CR	.0070	--	--	--
CU	.0040	--	--	--
FE	67.	--	--	--
HG	<.00020	--	--	--
K	.46	--	.63	--
MG	77.	--	68.	--
MN	1.4	--	--	--
MO	<1.0	--	--	--
NA	19.	--	21.	--
NI	.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.7	7.0	6.7	6.7
PO4	.37	--	--	--
SE	<.0010	--	--	--
SI	9.7	--	--	--
SO4	2.6	--	7.2	--
SR	<5.0	--	.17	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the dav before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 07A

TEST	830506	830507*	830811	830812*
	SAMPLING DATE			
AG	<.00020	--	--	--
AL	.18	--	--	--
ALKHCO3	330.	--	350.	--
ALKTOT	--	350.	--	420.
AS	<.0010	--	--	--
B	.060	--	.070	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	79.	--	85.	--
CD	<.00010	--	--	--
CL	13.	--	12.	--
CO	.0060	--	--	--
COND	63.	96.	66.	85.
CR	.0080	--	--	--
CU	.0030	--	--	--
FE	30.	--	--	--
HG	<.00020	--	--	--
K	.47	--	.81	--
MG	30.	--	31.	--
MN	8.4	--	--	--
MO	<1.0	--	--	--
NA	14.	--	16.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.7	7.3	6.6	6.6
PO4	.14	--	--	--
SE	<.0010	--	--	--
SI	17.	--	--	--
SO4	1.0	--	<.50	--
SR	<5.0	--	.13	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 07B

TEST	830506	830507★	830811	830812★
	SAMPLING DATE			
AG	<.00020	--	--	--
AL	.11	--	--	--
ALKHCO3	330.	--	420.	--
ALKTOT	--	390.	--	440.
AS	<.0010	--	--	--
B	.030	--	.080	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	72.	--	95.	--
CD	.00010	--	--	--
CL	11.	--	10.	--
CO	.0030	--	--	--
COND	61.	100.	74.	98.
CR	<.0050	--	--	--
CU	.0060	--	--	--
FE	41.	--	--	--
HG	<.00020	--	--	--
K	.19	--	1.3	--
MG	35.	--	41.	--
MN	1.5	--	--	--
MO	<1.0	--	--	--
NA	10.	--	14.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.5	7.1	6.7	6.6
PO4	.41	--	--	--
SE	<.0010	--	--	--
SI	15.	--	--	--
SO4	1.4	--	<.50	--
SR	<5.0	--	.11	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 08A

TEST	830506	830507*	830611	830612*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	.16	--	--	--
ALKHCO3	380.	--	470.	--
ALKTOT	--	550.	--	730.
AS	.0020	--	--	--
B	.070	--	.13	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	89.	--	110.	--
CD	<.00010	--	--	--
CL	5.7	--	3.4	--
CO	.0030	--	--	--
COND	67.	140.	82.	130.
CR	.0090	--	--	--
CU	.0030	--	--	--
FE	110.	--	--	--
HG	<.00020	--	--	--
K	.66	--	2.4	--
MG	37.	--	44.	--
MN	3.2	--	--	--
MO	<1.0	--	--	--
NA	9.1	--	10.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.4	6.8	6.6	6.7
PO4	1.1	--	--	--
SE	<.0010	--	--	--
SI	14.	--	--	--
SO4	.20	--	<.50	--
SR	<5.0	--	.15	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 068

TEST	SAMPLING DATE 830506	830507*	830811	830812*
AG	<.00020	--	--	--
AL	.13	--	--	--
ALKHCO3	460.	--	580.	--
ALKTOT	--	480.	--	660.
AS	<.0010	--	--	--
B	.16	--	.37	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	100.	--	140.	--
CD	<.00010	--	--	--
CL	2.4	--	30.	--
CO	.0050	--	--	--
COND	79.	110.	100.	130.
CR	<.0050	--	--	--
CU	.0060	--	--	--
FE	23.	--	--	--
HG	<.00020	--	--	--
K	.95	--	1.0	--
MG	46.	--	63.	--
MN	2.4	--	--	--
MO	<1.0	--	--	--
NA	20.	--	30.	--
NI	.0090	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.9	6.9	7.3	6.7
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	9.4	--	--	--
SO4	14.	--	.60	--
SR	<5.0	--	.17	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 09A

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	.20	--	--	--
ALKHCO3	280.	--	270.	--
ALKTOT	--	310.	--	330.
AS	<.0010	--	--	--
B	.020	--	.070	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	63.	--	63.	--
CD	<.00010	--	--	--
CL	12.	--	14.	--
CO	.011	--	--	--
COND	53.	80.	54.	70.
CR	.010	--	--	--
CU	.0030	--	--	--
FE	31.	--	--	--
HG	<.00020	--	--	--
K	.68	--	.93	--
MG	28.	--	28.	--
MN	5.7	--	--	--
MO	<1.0	--	--	--
NA	10.	--	12.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	.0020	--	--	--
PH	6.8	6.5	6.6	6.6
PO4	.41	--	--	--
SE	<.0010	--	--	--
SI	16.	--	--	--
SO4	.40	--	1.5	--
SR	<5.0	--	.090	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 09B

TEST	SAMPLING DATE 830506	830507*	830611	830812*
AG	<.00020	--	--	--
AL	.18	--	--	--
ALKHCO3	510.	--	240.	--
ALKTOT	--	290.	--	290.
AS	<.0010	--	--	--
B	.10	--	.14	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	62.	--	57.	--
CD	<.00010	--	--	--
CL	18.	--	11.	--
CO	.0020	--	--	--
COND	52.	80.	48.	60.
CR	.0080	--	--	--
CU	.010	--	--	--
FE	12.	--	--	--
HG	.00020	--	--	--
K	1.5	--	1.4	--
MG	26.	--	22.	--
MN	1.4	--	--	--
MO	<1.0	--	--	--
NA	14.	--	11.	--
NI	.012	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.4	7.8	7.6	6.5
PO4	.78	--	--	--
SE	<.0010	--	--	--
SI	14.	--	--	--
SO4	.60	--	1.3	--
SR	<5.0	--	.060	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 10A

TEST	SAMPLING DATE 830506	830507*	830811	830812*
AG	<.00020	--	--	--
AL	.10	--	--	--
ALKHCO3	370.	--	430.	--
ALKTOT	--	390.	--	470.
AS	<.0010	--	--	--
B	.050	--	.16	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	81.	--	130.	--
CD	<.00010	--	--	--
CL	15.	--	13.	--
CO	.0070	--	--	--
COND	69.	91.	99.	110.
CR	<.0050	--	--	--
CU	.0020	--	--	--
FE	2.2	--	--	--
HG	.00020	--	--	--
K	.83	--	.97	--
MG	38.	--	56.	--
MN	1.6	--	--	--
MO	<1.0	--	--	--
NA	14.	--	25.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.7	7.0	6.8	6.6
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	18.	--	--	--
SO4	.40	--	110.	--
SR	<5.0	--	.26	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 10B

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	.19	--	--	--
ALKHCO3	450.	--	470.	--
ALKTOT	--	460.	--	490.
AS	<.0010	--	--	--
B	.070	--	.14	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	88.	--	110.	--
CD	<.00010	--	--	--
CL	13.	--	10.	--
CO	.0020	--	--	--
COND	79.	93.	98.	110.
CR	<.0050	--	--	--
CU	.0060	--	--	--
FE	5.7	--	--	--
HG	.00020	--	--	--
K	.78	--	.93	--
MG	48.	--	56.	--
MN	1.4	--	--	--
MO	<1.0	--	--	--
NA	22.	--	40.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.8	7.1	7.0	6.7
PO4	.064	--	--	--
SE	<.0010	--	--	--
SI	14.	--	--	--
SO4	.20	--	83.	--
SR	<5.0	--	.20	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 11A

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	.34	--	--	--
ALKHCO3	460.	--	510.	--
ALKTOT	--	490.	--	590.
AS	.0020	--	--	--
B	.070	--	.13	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	100.	--	110.	--
CD	<.00010	--	--	--
CL	19.	--	14.	--
CO	.0030	--	--	--
COND	83.	110.	92.	110.
CR	.014	--	--	--
CU	.0010	--	--	--
FE	29.	--	--	--
HG	<.00020	--	--	--
K	.70	--	.95	--
MG	48.	--	51.	--
MN	2.7	--	--	--
MO	<1.0	--	--	--
NA	18.	--	24.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.7	6.8	6.8	6.6
PO4	.19	--	--	--
SE	<.0010	--	--	--
SI	17.	--	--	--
SO4	.20	--	3.5	--
SR	<5.0	--	.22	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 11B

TEST	SAMPLING DATE 830506	830507*	830811	830812*
AG	<.00020	--	--	--
AL	.10	--	--	--
ALKHCO3	600.	--	720.	--
ALKTOT	--	620.	--	740.
AS	<.0010	--	--	--
B	.15	--	.28	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	130.	--	150.	--
CD	<.00010	--	--	--
CL	13.	--	13.	--
CO	.0020	--	--	--
COND	100.	130.	120.	130.
CR	.0050	--	--	--
CU	.0020	--	--	--
FE	15.	--	--	--
HG	.00020	--	--	--
K	.70	--	.54	--
MG	70.	--	79.	--
MN	1.8	--	--	--
MO	<1.0	--	--	--
NA	14.	--	15.	--
NI	.012	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.6	6.6	7.3	6.7
PO4	.23	--	--	--
SE	<.0010	--	--	--
SI	12.	--	--	--
SO4	2.9	--	<.50	--
SR	<5.0	--	.23	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 12A

SAMPLING DATE

TEST	830506	830507*	830811	830812*
AG	<.00020	--	--	--
AL	.060	--	--	--
ALKHCO3	550.	--	580.	--
ALKTOT	--	580.	--	640.
AS	.0030	--	--	--
B	.18	--	.34	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	130.	--	140.	--
CD	<.00010	--	--	--
CL	14.	--	13.	--
CO	.0070	--	--	--
COND	97.	130.	100.	120.
CR	.0070	--	--	--
CU	<.0010	--	--	--
FE	53.	--	--	--
HG	<.00020	--	--	--
K	2.3	--	4.4	--
MG	56.	--	55.	--
MN	4.2	--	--	--
MO	<1.0	--	--	--
NA	16.	--	26.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.8	7.0	7.0	6.7
PO4	.49	--	--	--
SE	<.0010	--	--	--
SI	14.	--	--	--
SO4	.60	--	<.50	--
SR	<5.0	--	.34	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 12B

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	.12	--	--	--
ALKHCO3	610.	--	510.	--
ALKTOT	--	630.	--	570.
AS	.0020	--	--	--
B	.21	--	.36	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	150.	--	130.	--
CD	<.00010	--	--	--
CL	11.	--	8.8	--
CO	.0030	--	--	--
COND	100.	150.	94.	110.
CR	.0013	--	--	--
CU	.0020	--	--	--
FE	57.	--	--	--
HG	<.00020	--	--	--
K	2.4	--	4.4	--
MG	57.	--	45.	--
MN	1.9	--	--	--
MO	<1.0	--	--	--
NA	22.	--	22.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.8	7.0	7.2	6.6
PO4	.25	--	--	--
SE	<.0010	--	--	--
SI	11.	--	--	--
SO4	.20	--	<.50	--
SR	<5.0	--	.35	--
TH	<.0050	--	--	--
TI	<1.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 13A

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	<.050	--	--	--
ALKHCO3	280.	--	280.	--
ALKTOT	--	330.	--	330.
AS	<.0010	--	--	--
B	.080	--	.12	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	69.	--	69.	--
CD	.00040	--	--	--
CL	9.2	--	8.6	--
CO	.0090	--	--	--
COND	56.	95.	54.	72.
CR	<.0050	--	--	--
CU	.0020	--	--	--
FE	77.	--	--	--
HG	<.00020	--	--	--
K	.86	--	1.1	--
MG	30.	--	28.	--
MN	.53	--	--	--
MO	<1.0	--	--	--
NA	8.4	--	9.1	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.3	6.9	6.9	6.5
PO4	1.3	--	--	--
SE	<.0010	--	--	--
SI	17.	--	--	--
SO4	14.	--	6.0	--
SR	<5.0	--	.090	--
TH	<.0050	--	--	--
TI	2.3	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 138

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	<.050	--	--	--
ALKHCO3	240.	--	220.	--
ALKTOT	--	250.	--	360.
AS	<.0010	--	--	--
B	.12	--	.20	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	51.	--	64.	--
CD	.00030	--	--	--
CL	9.0	--	8.8	--
CO	.0060	--	--	--
COND	49.	78.	44.	70.
CR	<.0050	--	--	--
CU	<.0010	--	--	--
FE	13.	--	--	--
HG	<.00020	--	--	--
K	.67	--	.83	--
MG	30.	--	33.	--
MN	.54	--	--	--
MO	<1.0	--	--	--
NA	10.	--	11.	--
NI	.020	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	7.6	6.6	7.2	6.3
PO4	1.8	--	--	--
SE	<.0010	--	--	--
SI	15.	--	--	--
SO4	13.	--	4.1	--
SR	<5.0	--	.070	--
TH	<.0050	--	--	--
TI	2.5	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 15A

SAMPLING DATE

TEST	830506	830507*	830811	830812*
AG	<.00020	--	--	--
AL	.20	--	--	--
ALKHCO3	320.	--	300.	--
ALKTOT	--	350.	--	390.
AS	<.0010	--	--	--
B	.11	--	.11	--
BA	.20	--	--	--
BE	<.00020	--	--	--
CA	88.	--	78.	--
CD	<.00010	--	--	--
CL	13.	--	14.	--
CO	.0050	--	--	--
COND	63.	96.	63.	80.
CR	.0070	--	--	--
CU	<.0010	--	--	--
FE	56.	--	--	--
HG	<.00020	--	--	--
K	1.8	--	2.1	--
MG	35.	--	31.	--
MN	3.4	--	--	--
MO	<1.0	--	--	--
NA	17.	--	12.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.4	6.9	6.6	6.6
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	18.	--	--	--
SO4	5.4	--	32.	--
SR	<5.0	--	.1	--
TH	<.0050	--	--	--
TI	2.6	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 15B

TEST	830506	830507*	830611	830612*
	SAMPLING DATE			
AG	<.00020	--	--	--
AL	<.050	--	--	--
ALKHCO3	480.	--	470.	--
ALKTOT	--	500.	--	330.
AS	<.0010	--	--	--
B	.95	--	.21	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	120.	--	110.	--
CD	.00010	--	--	--
CL	14.	--	16.	--
CO	.0020	--	--	--
COND	91.	120.	85.	98.
CR	<.0050	--	--	--
CU	.0030	--	--	--
FE	21.	--	--	--
HG	<.00020	--	--	--
K	1.5	--	2.5	--
MG	54.	--	48.	--
MN	.35	--	--	--
MO	<1.0	--	--	--
NA	9.4	--	10.	--
NI	.030	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.8	6.9	7.1	6.5
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	14.	--	--	--
SO4	14.	--	8.5	--
SR	<5.0	--	.12	--
TH	<.0050	--	--	--
TI	2.2	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 16A

TEST	SAMPLING DATE 830506	830507*	830811	830812*
AG	--	--	--	--
AL	<.050	--	--	--
ALKHCO3	160.	--	210.	--
ALKTOT	--	220.	--	340.
AS	--	--	--	--
B	.95	--	.74	--
BA	<.20	--	--	--
BE	--	--	--	--
CA	--	--	60.	--
CD	--	--	--	--
CL	12.	--	16.	--
CO	<.0020	--	--	--
COND	79.	120.	77.	100.
CR	<.0050	--	--	--
CU	--	--	--	--
FE	--	--	--	--
HG	--	--	--	--
K	--	--	1.6	--
MG	--	--	35.	--
MN	<.050	--	--	--
MO	<1.0	--	--	--
NA	--	--	20.	--
NI	--	--	--	--
NO3	<.20	--	--	--
PB	--	--	--	--
PH	6.2	7.0	6.3	6.5
PO4	<.0050	--	--	--
SE	--	--	--	--
SI	15.	--	--	--
SO4	290.	--	240.	--
SR	<5.0	--	.16	--
TH	<.0050	--	--	--
TI	1.3	--	--	--
V	<.0050	--	--	--
ZN	--	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 16B

SAMPLING DATE

TEST	830506	830607*	830811	830812*
AG	<.00020	--	--	--
AL	<.050	--	--	--
ALKHCO3	210.	--	220.	--
ALKTOT	--	230.	--	310.
AS	<.0010	--	--	--
B	.16	--	.50	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	140.	--	130.	--
CD	.00010	--	--	--
CL	11.	--	14.	--
CO	.0080	--	--	--
COND	88.	130.	--	110.
CR	.013	--	--	--
CU	.0010	--	--	--
FE	35.	--	--	--
HG	<.00020	--	--	--
K	.67	--	.88	--
MG	35.	--	37.	--
MN	3.1	--	--	--
MO	<1.0	--	--	--
NA	12.	--	14.	--
NI	.025	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.8	7.0	7.3	6.4
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	11.	--	--	--
SO4	310.	--	320.	--
SR	<5.0	--	.12	--
TH	<.0050	--	--	--
TI	5.2	--	--	--
V	.0060	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 18A

TEST	SAMPLING DATE 830506	830507*	830811	830812*
AG	<.00020	--	--	--
AL	<.050	--	--	--
ALKHCO3	340.	--	360.	--
ALKTOT	--	350.	--	400.
AS	<.0010	--	--	--
B	.19	--	.31	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	120.	--	110.	--
CD	<.00010	--	--	--
CL	110.	--	56.	--
CO	.0050	--	--	--
COND	69.	110.	79.	84.
CR	.010	--	--	--
CU	.0040	--	--	--
FE	.12	--	--	--
HG	.00050	--	--	--
K	.90	--	1.7	--
MG	33.	--	29.	--
MN	.18	--	--	--
NO	<1.0	--	--	--
NA	21.	--	16.	--
NI	.0060	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.7	7.1	7.1	6.7
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	9.4	--	--	--
SO4	20.	--	20.	--
SR	<5.0	--	.32	--
TH	<.0050	--	--	--
TI	2.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 108

TEST	SAMPLING DATE 830506	830507*	830611	830612*
AG	<.00020	--	--	--
AL	<.050	--	--	--
ALKHCO3	390.	--	--	--
ALKTOT	--	400.	--	--
AS	<.0010	--	--	--
B	.32	--	--	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	120.	--	120.	--
CD	<.00010	--	--	--
CL	23.	--	--	--
CO	.0040	--	--	--
COND	72.	86.	--	82.
CR	.0060	--	--	--
CU	<.0040	--	--	--
FE	.27	--	--	--
HG	.00050	--	--	--
K	1.7	--	1.0	--
MG	30.	--	35.	--
MN	.12	--	--	--
MO	<1.0	--	--	--
NA	9.9	--	10.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	8.1	7.2	--	6.9
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	8.7	--	--	--
SO4	4.3	--	--	--
SR	<5.0	--	.19	--
TH	<.0050	--	--	--
TI	1.6	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 19A

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	.12	--	--	--
ALKHCO3	260.	--	160.	--
ALKTOT	--	220.	--	190.
AS	.0020	--	--	--
B	.15	--	.10	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	67.	--	44.	--
CD	.022	--	--	--
CL	64.	--	7.7	--
CO	.0080	--	--	--
COND	72.	74.	33.	36.
CR	<.0050	--	--	--
CU	.013	--	--	--
FE	.080	--	--	--
HG	<.00020	--	--	--
K	5.5	--	1.2	--
MG	18.	--	11.	--
MN	1.4	--	--	--
MO	<1.0	--	--	--
NA	35.	--	6.4	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	7.0	6.6	7.1	6.8
PO4	2.3	--	--	--
SE	<.0010	--	--	--
SI	9.4	--	--	--
SO4	37.	--	12.	--
SR	<5.0	--	.060	--
TH	<.0050	--	--	--
TI	2.7	--	--	--
V	<.050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 19B

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	<.050	--	--	--
ALKHCO3	93.	--	--	--
ALKTOT	--	90.	--	--
AS	<.0010	--	--	--
B	.020	--	--	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	26.	--	36.	--
CD	.00020	--	--	--
CL	17.	--	--	--
CO	.0020	--	--	--
COND	29.	37.	--	34.
CR	<.0050	--	--	--
CU	.0070	--	--	--
FE	.050	--	--	--
HG	<.00020	--	--	--
K	.86	--	.76	--
MG	12.	--	15.	--
MN	.62	--	--	--
MO	<1.0	--	--	--
NA	14.	--	8.6	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	7.2	6.9	--	6.8
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	8.7	--	--	--
SO4	29.	--	--	--
SR	<5.0	--	.060	--
TH	<.0050	--	--	--
TI	2.5	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 20A

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	<.050	--	--	--
ALKHCO3	500.	--	690.	--
ALKTOT	--	510.	--	740.
AS	<.0010	--	--	--
B	.20	--	.48	--
BA	<.20	--	--	--
BE	<.00020	--	--	--
CA	140.	--	170.	--
CD	.00070	--	--	--
CL	17.	--	19.	--
CO	.010	--	--	--
COND	100.	130.	120.	140.
CR	<.0050	--	--	--
CU	.018	--	--	--
FE	8.0	--	--	--
HG	<.00020	--	--	--
K	2.3	--	3.1	--
MG	50.	--	58.	--
MN	.77	--	--	--
MO	<1.0	--	--	--
NA	39.	--	43.	--
NI	.035	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	7.9	7.2	7.0	6.6
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	8.3	--	--	--
SO4	93.	--	44.	--
SR	<5.0	--	.20	--
TH	<.0050	--	--	--
TI	2.0	--	--	--
V	<.0050	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 20B

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	--	--	--	--
ALKHCO3	350.	--	400.	--
ALKTOT	--	350.	--	470.
AS	<.0010	--	--	--
B	.16	--	.25	--
BA	--	--	--	--
BE	<.00020	--	--	--
CA	100.	--	120.	--
CD	.00020	--	--	--
CL	7.3	--	9.6	--
CO	--	--	--	--
COND	74.	88.	84.	90.
CR	--	--	--	--
CU	.0050	--	--	--
FE	1.2	--	--	--
HG	<.00020	--	--	--
K	1.3	--	1.7	--
MG	36.	--	39.	--
MN	--	--	--	--
MO	--	--	--	--
NA	12.	--	17.	--
NI	.017	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.8	7.1	6.9	6.6
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	8.0	--	--	--
SO4	66.	--	90.	--
SR	--	--	.12	--
TH	--	--	--	--
TI	--	--	--	--
V	--	--	--	--
ZN	.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : Z1A

TEST	SAMPLING DATE 830506	830507*	830811	830812*
AG	<.00020	--	--	--
AL	--	--	--	--
ALKHCO3	160.	--	190.	--
ALKTOT	--	200.	--	190.
AS	<.0010	--	--	--
B	.10	--	.10	--
BA	--	--	--	--
BE	<.00020	--	--	--
CA	45.	--	48.	--
CD	.00040	--	--	--
CL	18.	--	18.	--
CO	--	--	--	--
COND	38.	48.	43.	45.
CR	--	--	--	--
CU	.010	--	--	--
FE	.20	--	--	--
HG	<.00020	--	--	--
K	.97	--	1.3	--
MG	17.	--	19.	--
MN	--	--	--	--
MO	--	--	--	--
NA	7.5	--	9.0	--
NI	.010	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	6.9	6.5	6.9	6.6
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	12.	--	--	--
SO4	14.	--	20.	--
SR	--	--	.080	--
TH	--	--	--	--
TI	--	--	--	--
V	--	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 21B

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	--	--	--	--
ALKHCO3	140.	--	100.	--
ALKTOT	--	160.	--	160.
AS	<.0010	--	--	--
B	.29	--	.25	--
BA	--	--	--	--
BE	<.00020	--	--	--
CA	40.	--	29.	--
CD	.0090	--	--	--
CL	18.	--	13.	--
CO	--	--	--	--
COND	33.	38.	--	28.
CR	--	--	--	--
CU	.038	--	--	--
FE	6.9	--	--	--
HG	.00050	--	--	--
K	1.3	--	1.5	--
MG	10.	--	9.1	--
MN	--	--	--	--
MO	--	--	--	--
NA	16.	--	12.	--
NI	.046	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	7.2	6.9	7.6	6.4
PO4	.040	--	--	--
SE	<.0010	--	--	--
SI	10.	--	--	--
SO4	5.3	--	9.0	--
SR	--	--	.050	--
TH	--	--	--	--
TI	--	--	--	--
V	--	--	--	--
ZN	<.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 22A

TEST	830506	830507*	830811	830812*
		SAMPLING DATE		
AG	<.00020	--	--	--
AL	--	--	--	--
ALKHCO3	510.	--	510.	--
ALKTOT	--	520.	--	530.
AS	<.0010	--	--	--
B	.11	--	.18	--
BA	--	--	--	--
BE	<.00020	--	--	--
CA	130.	--	120.	--
CD	<.00010	--	--	--
CL	18.	--	21.	--
CO	--	--	--	--
COND	95.	120.	98.	110.
CR	--	--	--	--
CU	.027	--	--	--
FE	13.	--	--	--
HG	<.00020	--	--	--
K	1.3	--	1.5	--
MG	46.	--	44.	--
MN	--	--	--	--
MO	--	--	--	--
NA	38.	--	37.	--
NI	<.0050	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	7.4	7.4	7.1	6.9
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	14.	--	--	--
SO4	36.	--	29.	--
SR	--	--	.21	--
TH	--	--	--	--
TI	--	--	--	--
V	--	--	--	--
ZN	.020	--	--	--

*TBTGS data obtained on fresh samples taken on the day before that shown.

ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983

LOCATION : 22B

TEST	SAMPLING DATE 830506	830507*	830811	830812*
AG	<.00020	--	--	--
AL	--	--	--	--
ALKHCO3	490.	--	480.	--
ALKTOT	--	510.	--	480.
AS	<.0010	--	--	--
B	.19	--	.28	--
BA	--	--	--	--
BE	<.00020	--	--	--
CA	130.	--	120.	--
CD	<.00010	--	--	--
CL	2.9	--	2.6	--
CO	--	--	--	--
COND	98.	120.	94.	98.
CR	--	--	--	--
CU	.0050	--	--	--
FE	4.8	--	--	--
HG	<.00020	--	--	--
K	.79	--	.91	--
MG	51.	--	54.	--
MN	--	--	--	--
MO	--	--	--	--
NA	33.	--	17.	--
NI	.053	--	--	--
NO3	<.20	--	--	--
PB	<.0020	--	--	--
PH	7.4	7.2	6.8	6.5
PO4	<.0050	--	--	--
SE	<.0010	--	--	--
SI	7.6	--	--	--
SO4	100.	--	83.	--
SR	--	--	.12	--
TH	--	--	--	--
TI	--	--	--	--
V	--	--	--	--
ZN	.020	--	--	--

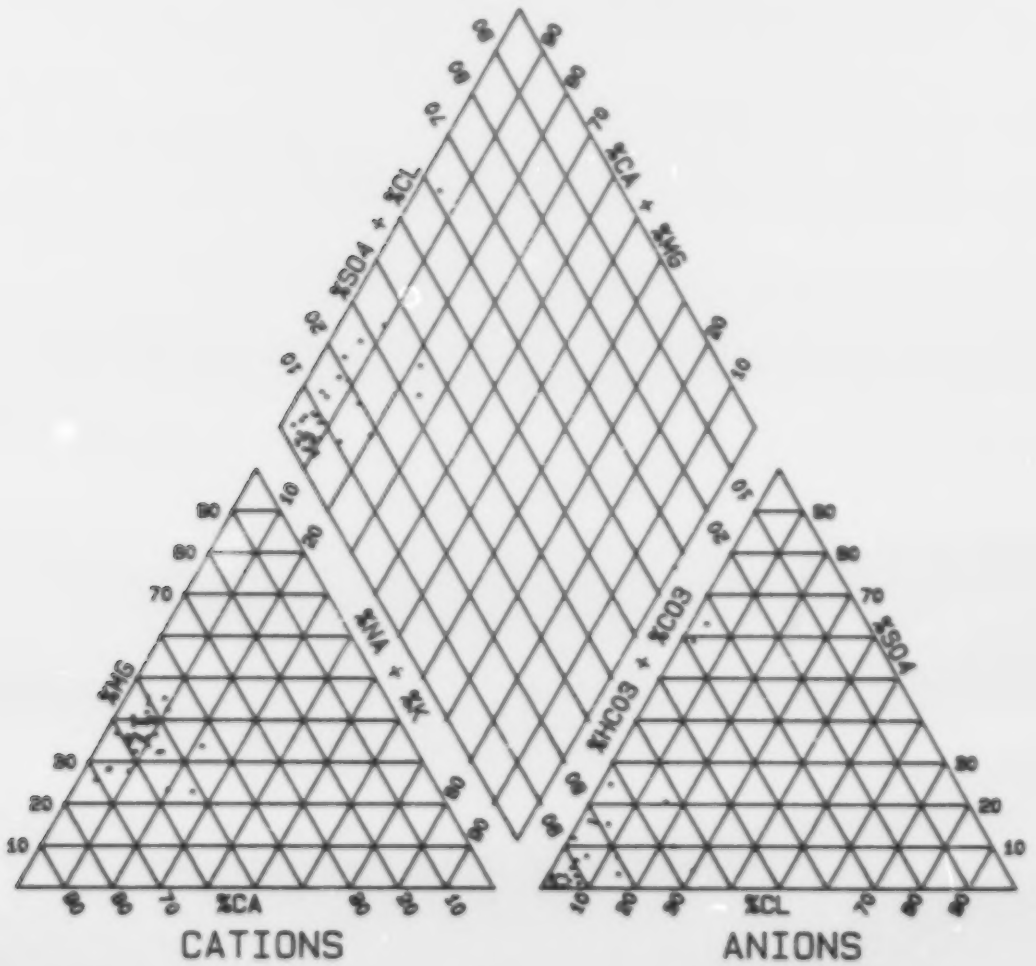
*TBTGS data obtained on fresh samples taken on the day before that shown.

APPENDIX B

POST-OPERATIONAL ASH CELL
GROUNDWATER QUALITY STUDIES - 1983
THUNDER BAY TGS EXTENSION

ION BALANCES
AND
PIPER DIAGRAMS

MAJOR ION CHEMISTRY
TBTGS ASH
MAY 06 1983
TYPE - WATER
ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983



MAJOR ION CHEMISTRY

TBTGS ASH
MAY 06 1983
TYPE - WATER

ASH CELL GROUNDWATER QUALITY-TBTGS-1983

LOCATION	CATIONS CA MG/L	CA EPM	CA %EPM	MG MG/L	MG EPM	MG %EPM	NA MG/L	NA EPM	NA %EPM	K MG/L	K EPM	K %EPM	CATION TOTAL EPM	ANION TOTAL EPM
01A	175	8.73	58	64	5.27	35	21	.91	6	1	.03	0	14.94	14.79
01B	126	6.28	59	47	3.87	36	12	.53	5	1	.03	0	10.71	10.50
02A	92	4.59	56	40	3.29	40	8	.37	4	1	.02	0	8.26	8.28
02B	132	6.58	71	29	2.39	26	7	.31	3	2	.05	1	9.33	9.08
03A	115	5.74	59	41	3.37	35	14	.60	6	1	.03	0	9.74	9.80
03B	131	6.53	61	48	3.95	37	6	.27	3	1	.01	0	10.77	10.53
04A	76	3.79	56	28	2.30	34	16	.70	10	1	.02	0	6.81	6.64
04B	147	7.33	59	49	4.03	32	25	1.08	9	0	.00	0	12.45	12.39
04C	113	5.64	59	40	3.29	35	13	.58	6	1	.03	0	9.53	9.34
05A	92	4.59	57	35	2.88	36	14	.61	8	1	.02	0	8.11	7.91
05B	70	3.49	57	27	2.22	36	9	.40	7	0	.01	0	6.12	6.31
06A	144	7.18	56	55	4.53	35	26	1.14	9	1	.02	0	12.88	12.66
06B	147	7.33	50	77	6.34	44	19	.84	6	0	.01	0	14.52	14.44
07A	79	3.94	56	30	2.47	35	14	.60	8	0	.01	0	7.02	6.99
07B	72	3.59	52	35	2.88	42	10	.44	6	0	.00	0	6.92	6.94
08A	89	4.44	56	37	3.05	39	9	.40	5	1	.02	0	7.90	7.76
08B	100	4.99	52	46	3.79	39	20	.85	9	1	.02	0	9.65	9.56
09A	63	3.14	53	28	2.30	39	10	.45	8	1	.02	0	5.91	5.94
09B	62	3.09	53	26	2.14	36	14	.60	10	2	.04	1	5.88	10.72*
10A	81	4.04	52	38	3.13	40	14	.59	8	1	.02	0	7.78	7.83
10B	88	4.39	47	48	3.95	42	22	.96	10	1	.02	0	9.32	9.37
11A	101	5.04	51	48	3.95	40	18	.79	8	1	.02	0	9.80	9.74
11B	127	6.33	50	70	5.76	45	14	.60	5	1	.02	0	12.71	12.42
12A	128	6.38	54	56	4.61	39	16	.71	6	2	.06	1	11.77	11.40
12B	148	7.38	56	57	4.69	36	22	.96	7	2	.06	0	13.09	12.51
13A	69	3.44	55	30	2.47	39	8	.37	6	1	.02	0	6.30	6.15
13B	51	2.54	46	30	2.47	45	10	.45	8	1	.02	0	5.48	5.32
15A	88	4.39	55	35	2.88	36	17	.75	9	1	.03	0	8.05	6.88*
*15B	121	6.03	55	54	4.44	41	9	.41	4	2	.04	0	10.93	10.28
16A	0	.00	0	0	.00	0	0	.00	0	0	.00	0	.00	9.57*+
16B	138	6.88	67	35	2.88	28	12	.52	5	1	.02	0	10.30	10.96
18A	123	6.13	63	33	2.72	28	22	.93	10	1	.02	0	9.81	10.*1
18B	116	5.79	66	30	2.47	28	10	.43	5	2	.04	1	8.73	8.54
19A	67	3.34	52	18	1.48	23	35	1.51	23	5	.14	2	6.47	7.77*
19B	26	1.30	44	12	.99	34	14	.63	21	1	.02	1	2.93	2.94
20A	139	6.93	54	50	4.12	32	39	1.70	13	2	.06	0	12.81	12.41
*20B	104	5.19	60	36	2.96	34	12	.53	6	1	.03	0	8.71	8.58
*21A	45	2.24	56	17	1.40	35	8	.33	8	1	.02	1	4.00	4.00
21B	40	2.00	57	10	.82	23	16	.68	19	1	.03	1	3.53	3.42
22A	125	6.23	53	46	3.79	32	38	1.66	14	1	.03	0	11.71	11.45

* INDICATES ANION AND CATION TOTALS DON'T LIE WITHIN 10% OF EACH OTHER.

+ INDICATES A MAJOR PARAMETER IS MISSING.

MAJOR ION CHEMISTRY

TBTGS ASH
MAY 06 1983
TYPE - WATER

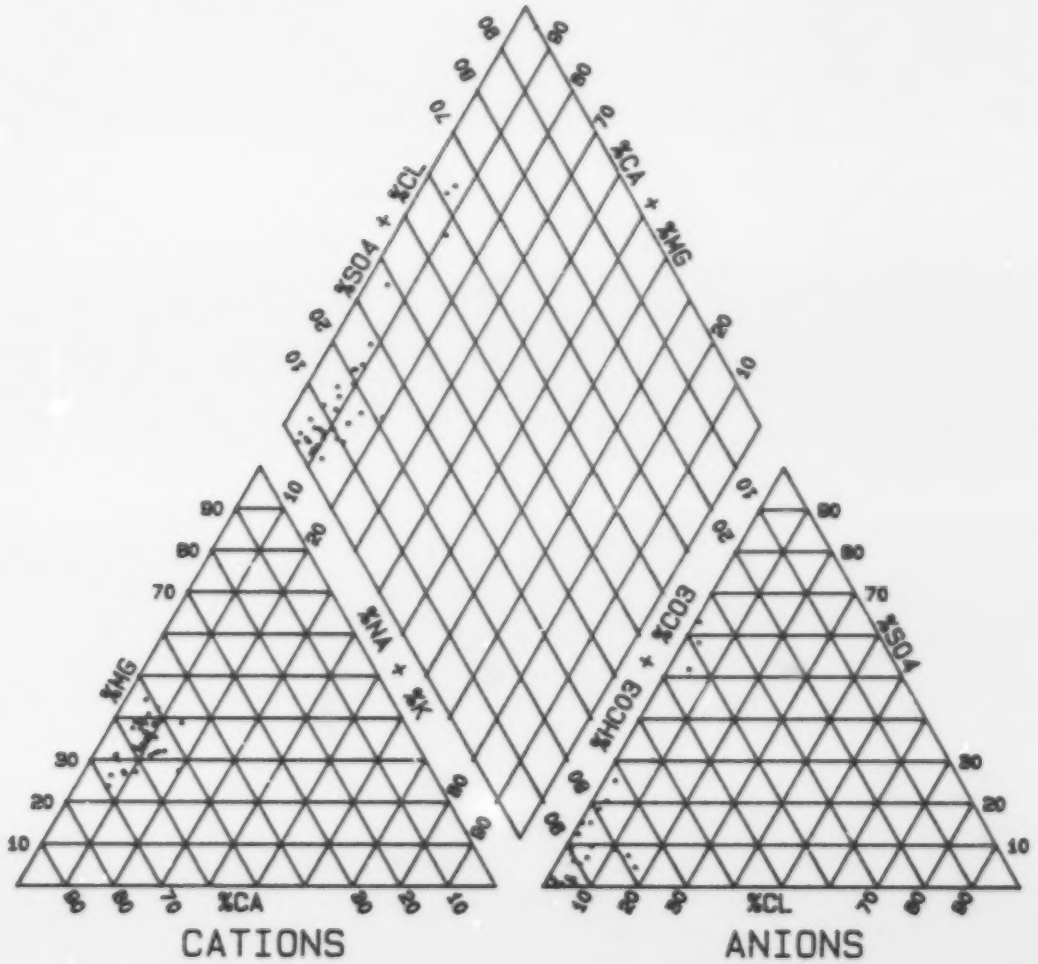
ASH CELL GROUNDWATER QUALITY-TBTGS-1983

	ANIONS												ANION	CATION
	CL			SO4			HCO3			CO3			TOTAL	TOTAL
LOCATION	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM	EPM	EPM
01A	31	.87	6	54	1.12	8	781	12.80	87	0	.00	0	14.79	14.94
01B	25	.70	7	77	1.60	15	500	8.20	78	0	.00	0	10.50	10.71
02A	4	.11	1	47	.98	12	439	7.20	87	0	.00	0	8.28	8.26
02B	8	.22	2	13	.27	3	525	8.60	95	0	.00	0	9.08	9.33
03A	6	.18	2	11	.23	2	573	9.40	96	0	.00	0	9.80	9.74
03B	6	.16	2	8	.17	2	622	10.20	97	0	.00	0	10.53	10.77
04A	8	.22	3	1	.03	0	390	6.40	96	0	.00	0	6.64	6.81
04B	20	.56	5	2	.03	0	720	11.80	95	0	.00	0	12.39	12.45
04C	7	.20	2	7	.14	1	549	9.00	96	0	.00	0	9.34	9.53
05A	17	.48	6	11	.23	3	439	7.20	91	0	.00	0	7.91	8.11
05B	6	.15	2	75	1.56	25	281	4.60	73	0	.00	0	6.31	6.12
06A	15	.42	3	2	.04	0	744	12.20	96	0	.00	0	12.66	12.88
06B	7	.19	1	3	.05	0	866	14.20	98	0	.00	0	14.44	14.52
07A	13	.37	5	1	.02	0	403	6.60	94	0	.00	0	6.99	7.02
07B	11	.31	4	1	.03	0	403	6.60	95	0	.00	0	6.94	6.92
08A	6	.16	2	0	.00	0	464	7.60	98	0	.00	0	7.76	7.90
08B	2	.07	1	14	.29	3	561	9.20	96	0	.00	0	9.56	9.65
09A	12	.34	6	0	.01	0	342	5.60	94	0	.00	0	5.94	5.91
09B	18	.51	5	1	.01	0	622	10.20	95	0	.00	0	10.72	5.88*
10A	15	.42	5	0	.01	0	451	7.40	94	0	.00	0	7.83	7.78
10B	13	.37	4	0	.00	0	549	9.00	96	0	.00	0	9.37	9.32
11A	19	.54	5	0	.00	0	561	9.20	94	0	.00	0	9.74	9.80
11B	13	.37	3	3	.06	0	732	12.00	97	0	.00	0	12.42	12.71
12A	14	.39	3	1	.01	0	671	11.00	96	0	.00	0	11.40	11.77
12B	11	.31	2	0	.00	0	744	12.20	97	0	.00	0	12.51	13.09
13A	9	.26	4	14	.29	5	342	5.60	91	0	.00	0	6.15	6.30
13B	9	.25	5	13	.27	5	293	4.80	90	0	.00	0	5.32	5.48
15A	13	.37	5	5	.11	2	390	6.40	93	0	.00	0	6.88	8.05*
15B	14	.39	4	14	.29	3	586	9.60	93	0	.00	0	10.28	10.93
16A	12	.34	4	290	6.04	63	195	3.20	33	0	.00	0	9.57	.00*
16B	11	.31	3	310	6.45	59	256	4.20	38	0	.00	0	10.96	10.30
18A	110	3.10	30	20	.42	4	415	6.80	66	0	.00	0	10.31	9.81
18B	23	.65	8	4	.09	1	476	7.80	91	0	.00	0	8.54	8.73
19A	64	1.80	23	37	.77	10	317	5.20	67	0	.00	0	7.77	6.47*
19B	17	.48	16	29	.60	21	113	1.86	63	0	.00	0	2.94	2.93
20A	17	.48	4	93	1.94	16	610	10.00	81	0	.00	0	12.41	12.81
20B	7	.21	2	66	1.37	16	427	7.00	82	0	.00	0	8.58	8.71
21A	18	.51	13	14	.29	7	195	3.20	80	0	.00	0	4.00	4.00
21B	18	.51	15	5	.11	3	171	2.80	82	0	.00	0	3.42	3.53
22A	18	.51	4	36	.75	7	622	10.20	89	0	.00	0	11.45	11.71

* INDICATES ANION AND CATION TOTALS DON'T LIE WITHIN 10% OF EACH OTHER.

+ INDICATES A MAJOR PARAMETER IS MISSING.

MAJOR ION CHEMISTRY
TBTGS ASH
AUG 11 1983
TYPE - WATER
ASH CELL AREA GROUNDWATER QUALITY-TBTGS-1983



MAJOR ION CHEMISTRY

TBTGS ASH
AUG 11 1983
TYPE - WATER

ASH CELL GROUNDWATER QUALITY-TBTGS-1983

	CATIONS												CATION TOTAL	ANION TOTAL
	CA			MG			NA			K				
LOCATION	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM	EPM	EPM
01A	156	7.78	55	55	4.53	32	22	.96	7	37	.95	7	14.21	12.74*
01B	127	6.33	64	37	3.05	31	10	.42	4	2	.05	0	9.85	9.70
02A	102	5.09	55	43	3.54	39	12	.52	6	1	.03	0	9.18	9.41
02B	140	6.98	67	33	2.72	26	14	.60	6	2	.05	1	10.35	10.32
03A	116	5.79	58	39	3.21	32	20	.87	9	2	.04	0	9.90	10.12
03B	198	9.88	69	41	3.37	24	22	.96	7	2	.06	0	14.26	12.86
04A	85	4.24	57	28	2.30	31	20	.87	12	1	.03	0	7.44	7.50
04B	132	6.58	62	35	2.88	27	26	1.13	11	2	.04	0	10.64	10.66
04C	116	5.79	60	39	3.21	33	16	.70	7	1	.03	0	9.72	9.52
05A	93	4.64	57	33	2.72	34	16	.70	9	2	.04	1	8.09	7.78
05B	72	3.59	55	29	2.39	37	12	.52	8	1	.03	0	6.53	6.36
06A	145	7.23	56	55	4.53	35	27	1.17	9	1	.03	0	12.96	12.59
06B	144	7.18	52	68	5.60	41	21	.91	7	1	.02	0	13.71	13.41
07A	85	4.24	56	31	2.55	34	16	.70	9	1	.02	0	7.51	7.34
07B	95	4.74	54	41	3.37	39	14	.61	7	1	.03	0	8.75	8.68
08A	111	5.54	57	44	3.62	38	10	.43	5	2	.06	1	9.65	9.49
08B	137	6.83	51	63	5.19	39	30	1.30	10	1	.03	0	13.35	12.46
09A	63	3.14	52	28	2.30	38	12	.52	9	1	.02	0	5.99	5.82
09B	57	2.84	55	22	1.81	35	11	.48	9	1	.04	1	5.17	5.14
10A	127	6.33	53	56	4.61	38	25	1.09	9	1	.02	0	12.05	11.25
10B	111	5.54	46	56	4.61	39	40	1.74	15	1	.02	0	11.91	11.41
11A	112	5.59	51	51	4.20	39	24	1.04	10	1	.02	0	10.85	10.66
11B	151	7.53	51	79	6.50	44	15	.65	4	1	.01	0	14.70	14.76
12A	13[illegible]	6.78	54	55	4.53	36	26	1.13	9	4	.11	1	12.55	11.96
12B	13[illegible]	6.68	58	45	3.70	32	22	.96	8	4	.11	1	11.46	10.44
13A	69	3.44	56	28	2.30	37	9	.40	6	1	.03	0	6.17	5.97
13B	64	3.19	50	33	2.72	42	11	.49	8	1	.02	0	6.42	4.73*
15A	78	3.89	55	31	2.55	36	12	.52	7	2	.05	1	7.02	7.06
15B	114	5.69	56	48	3.95	39	10	.43	4	3	.06	1	10.14	10.02
16A	88	4.39	54	35	2.88	35	20	.87	11	2	.04	1	8.18	9.64*
16B	131	6.53	64	37	3.05	30	14	.61	6	1	.02	0	10.21	11.45*
18A	113	5.64	64	29	2.39	27	16	.70	8	2	.04	0	8.76	9.19
19A	44	2.19	64	11	.91	27	6	.28	8	1	.03	1	3.41	3.67
20A	169	8.43	56	58	4.77	32	43	1.87	12	3	.08	1	15.15	15.25
20B	116	5.79	59	39	3.21	33	17	.74	8	2	.04	0	9.78	10.14
21A	48	2.39	55	19	1.56	36	9	.39	9	1	.03	1	4.38	4.72
21B	29	1.45	53	9	.75	27	12	.51	19	2	.04	1	2.74	2.55
22A	121	6.03	53	44	3.62	32	37	1.61	14	2	.04	0	11.30	11.39
22B	124	6.18	54	54	4.44	39	17	.74	6	1	.02	0	11.39	11.40
18B	118	5.89	64	35	2.88	31	10	.43	5	1	.03	0	9.23	.00*

* INDICATES ANION AND CATION TOTALS DON'T LIE WITHIN 10% OF EACH OTHER.

+ INDICATES A MAJOR PARAMETER IS MISSING.

MAJOR ION CHEMISTRY

TBTGS ASH
AUG 11 1983
TYPE - WATER

ASH CELL GROUNDWATER QUALITY-TBTGS-1983

	ANIONS												ANION TOTAL	CATION TOTAL
	CL			SO4			HCO3			CO3				
LOCATION	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM	MG/L	EPM	%EPM	EPM	EPM
01A	6	.16	1	76	1.58	12	671	11.00	86	0	.00	0	12.74	14.21*
01B	28	.79	8	140	2.91	30	366	6.00	62	0	.00	0	9.70	9.85
02A	5	.14	1	42	.87	9	512	8.40	89	0	.00	0	9.41	9.18
02B	5	.14	1	9	.19	2	610	10.00	97	0	.00	0	10.32	10.35
03A	9	.24	2	4	.09	1	598	9.80	97	0	.00	0	10.12	9.90
03B	5	.14	1	390	8.12	63	281	4.60	36	0	.00	0	12.86	14.26
04A	10	.28	4	1	.02	0	439	7.20	96	0	.00	0	7.50	7.44
04B	8	.23	2	40	.83	8	586	9.60	90	0	.00	0	10.66	10.64
04C	9	.25	3	3	.07	1	561	9.20	97	0	.00	0	9.52	9.72
05A	16	.45	6	6	.13	2	439	7.20	92	0	.00	0	7.78	8.09
05B	6	.16	3	77	1.60	25	281	4.60	72	0	.00	0	6.36	6.53
06A	14	.39	3	<.500	.00	0	744	12.20	97	0	.00	0	12.59	12.96 +
06B	9	.26	2	7	.15	1	793	13.00	97	0	.00	0	13.41	13.71
07A	12	.34	5	<.500	.00	0	427	7.00	95	0	.00	0	7.34	7.51 +
07B	10	.28	3	<.500	.00	0	512	8.40	97	0	.00	0	8.68	8.75 +
08A	3	.10	1	<.500	.00	0	573	9.40	99	0	.00	0	9.49	9.65 +
08B	30	.85	7	1	.02	0	708	11.60	93	0	.00	0	12.46	13.35
09A	14	.39	7	2	.03	1	329	5.40	93	0	.00	0	5.82	5.99
09B	11	.31	6	1	.03	1	293	4.80	93	0	.00	0	5.14	5.17
10A	13	.37	3	110	2.29	20	525	8.60	76	0	.00	0	11.25	12.05
10B	10	.28	2	83	1.73	15	573	9.40	82	0	.00	0	11.41	11.91
11A	14	.39	4	4	.07	1	622	10.20	96	0	.00	0	10.66	10.85
11B	13	.37	2	<.500	.00	0	878	14.40	98	0	.00	0	14.76	14.70 +
12A	13	.37	3	<.500	.00	0	708	11.60	97	0	.00	0	11.96	12.55 +
12B	9	.25	2	<.500	.00	0	622	10.20	98	0	.00	0	10.44	11.46 +
13A	9	.24	4	6	.12	2	342	5.60	94	0	.00	0	5.97	6.17
13B	9	.25	5	4	.09	2	268	4.40	93	0	.00	0	4.73	6.42*
15A	14	.39	6	32	.67	9	366	6.00	85	0	.00	0	7.06	7.02
15B	16	.45	4	9	.18	2	573	9.40	94	0	.00	0	10.02	10.14
16A	16	.45	5	240	4.99	52	256	4.20	44	0	.00	0	9.64	8.18*
16B	14	.39	3	320	6.66	58	268	4.40	38	0	.00	0	11.45	10.21*
18A	56	1.58	17	20	.42	5	439	7.20	78	0	.00	0	9.19	8.76
19A	8	.22	6	12	.25	7	195	3.20	87	0	.00	0	3.67	3.41
20A	19	.54	4	44	.92	6	842	13.80	90	0	.00	0	15.25	15.15
20B	10	.27	3	90	1.87	18	488	8.00	79	0	.00	0	10.14	9.78
21A	18	.51	11	20	.42	9	232	3.80	80	0	.00	0	4.72	4.38
21B	13	.37	14	9	.19	7	122	2.00	78	0	.00	0	2.55	2.74
22A	21	.59	5	29	.60	5	622	10.20	90	0	.00	0	11.39	11.30
22B	3	.07	1	83	1.73	15	586	9.60	84	0	.00	0	11.40	11.39
18B	0	.00	0	0	.00	0	0	.00	0	0	.00	0	.00	9.23*+

* INDICATES ANION AND CATION TOTALS DON'T LIE WITHIN 10% OF EACH OTHER.

+ INDICATES A MAJOR PARAMETER IS MISSING.

APPENDIX C

POST-OPERATIONAL ASH CELL
GROUNDWATER QUALITY STUDIES - 1983
THUNDER BAY TGS EXTENSION

ANNUAL METEOROLOGICAL SUMMARY
1983
THUNDER BAY A
ONTARIO
(ENVIRONMENT CANADA)

Environment Canada | Environnement Canada

Atmospheric Environment Service | Service de l'environnement atmosphérique

ANNUAL METEOROLOGICAL SUMMARY 1983

SOMMAIRE METEOROLOGIQUE ANNUEL

THUNDER BAY A
ONTARIO

UDC: 551.508.1
551.508.3

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Canada

ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL

for/pour THUNDER BAY "A", ONTARIO YEAR/ANNÉE 1983

METEOROLOGICAL DATA FOR THE YEAR / DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE

NOTE: The following units are used throughout this summary –
Temperature: Degrees and tenths Celcius (°C)
Degree Day: Difference of Daily Mean Temperature from 18.0°C
Rain: Millimetres and tenths (mm)
Snow: Centimetres and tenths (cm)
Total Precipitation: Millimetres and tenths (mm)
Wind Speed: Kilometres per hour (km/h)
Wind Direction: Direction (true north) from which the wind is blowing.
Barometric Pressure: Kilopascals and hundredths (kPa)
Sunshine: Hours and tenths of bright sunshine.

AVIS: Unités Utilisées –
Température: Degrés et dixième Celsius (°C)
Degré Jour: Différence entre la température moyenne du jour et 18.0°C
Pluie: Millimetres et dixièmes (mm)
Neige: Centimetres et dixièmes (cm)
Précipitation Totale: Millimetres et dixièmes (mm)
Vitesse du vent: Kilomètres par heure (km/h)
Direction du vent: Direction (nord géographique) d'ou le vent souffle
Pression Barométrique: Kilopascals et centièmes (kPa)
Insolation: Nombre d'heures et dixièmes d'insolation effective

MONTH / MOIS	TEMPERATURE / TEMPÉRATURE										DEGREE DAYS / DEGRÉS JOURS	
	MEAN / MOYENNE			NORMAL / NORMALE			EXTREME / EXTRÊME					
	MAXIMUM	MINIMUM	MONTHLY / MENSUELLES	MAXIMUM	MINIMUM	MEAN / MOYENNE	MAXIMUM / MAXIMALE	DATE	MINIMUM / MINIMALE	DATE	BELOW 18.0°C / AU DESSOUS DE 18.0°C	NORMAL / NORMALE
JAN/JAN	-5.6	-17.2	-11.4	-9.4	-21.3	-15.4	2.1	9	-29.0	18	911.1	1034.9
FEB/FÉV	-3.3	-12.3	-7.8	-6.2	-19.8	-13.0	4.8	14	-29.4	6,7	722.9	876.5
MAR/MAR	0.1	-8.2	-4.1	-0.2	-12.3	-6.3	7.6	8	-20.4	24	683.7	752.5
APR/AVR	7.1	-4.3	1.4	8.3	-3.3	2.5	21.9	25	-18.4	17	496.5	464.9
MAY/MAI	13.1	0.1	6.6	15.5	2.1	8.8	21.8	18	-5.9	S	353.5	285.6
JUN/JUIN	20.8	7.2	14.0	20.7	7.3	14.0	31.5	22	-0.6	8	132.6	126.1
JUL/JUIL	26.5	12.7	19.6	24.3	10.9	17.6	34.1	14	2.7	5	27.6	44.6
AUG/AOÛT	27.0	13.6	20.3	22.8	9.9	16.4	40.3	7	7.7	9	9.7	72.8
SEPT/SEP	19.3	6.8	13.1	17.0	5.1	11.1	31.4	2	-3.0	23	161.8	210.0
OCT/OCT	10.8	0.2	5.5	11.1	0.3	5.7	20.0	27	-6.7	19	386.4	381.2
NOV/NOV	2.8	-5.1	-1.2	1.9	-7.1	-2.6	12.9	6	-15.0	12	573.7	617.7
DEC/DÉC	-11.2	-22.1	-16.7	-5.8	-16.3	-11.1	-1.1	11	-33.3	19	1074.9	901.1
YEAR / ANNÉE	9.0	-2.4	3.3	8.3	-3.7	2.3	40.3	Aug. 7 Aout	-33.3	Dec. 19 Dec.	5534.4	5767.9

MONTH / MOIS	PRECIPITATION / PRÉCIPITATIONS													
	MONTHLY / MENSUELLES			NORMAL / NORMALE			EXTREME / EXTRÊME							
							RAIN / PLUIE				SNOW / NEIGE			
	RAINFALL / HAUTEUR DE PLUIE	SNOWFALL / HAUTEUR DE NEIGE	TOTAL	RAIN / PLUIE	SNOW / NEIGE	TOTAL	6 HRS	DATE	24 HRS	DATE	6 HRS	DATE	24 HRS	DATE
JAN/JAN	4.0	37.8	37.1	1.9	48.4	40.9	2.4	9	2.6	S	5.0	29	10.8	S
FEB/FÉV	4.8	33.1	34.2	1.9	30.7	28.3	3.6	27	4.8	S	4.0	19	10.4	19
MAR/MAR	32.7	12.8	42.1	13.7	34.2	45.0	15.0	6	27.7	S	3.4	9	4.1	9
APR/AVR	14.1	40.2	59.4	35.4	16.2	50.7	3.7	10	5.5	10	9.4	14	20.6	14
MAY/MAI	47.9	0.0	47.9	69.2	4.2	73.3	10.4	22	20.7	S				
JUN/JUIN	67.9	0.0	67.9	76.6	0.0	76.6	9.4	4	20.7	S				
JUL/JUIL	62.4	0.0	62.4	75.4	0.0	75.4	16.2	3	30.8	S				
AUG/AOÛT	108.0	0.0	108.0	83.1	0.0	83.1	17.8	10	38.9	10				
SEPT/SEP	83.8	TR	83.8	89.1	TR	89.1	19.8	10	26.5	S	TR	S	TR	S
OCT/OCT	66.4	8.3	74.7	51.6	3.3	54.8	9.6	13	16.7	S	7.0	14	8.3	S
NOV/NOV	73.3	30.6	103.7	25.3	29.8	52.9	11.2	20	34.9	S	4.8	21	8.5	S
DEC/DÉC	0.0	46.0	37.7	4.1	46.2	41.7	0.0		0.0		8.6	11	21.8	S
YEAR / ANNÉE	565.3	208.8	758.9	527.3	213.0	711.8	19.8	SEP 10	38.9	AUG 10	9.4	APR 14	21.8	DEC S

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ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL

for/pour THUNDER BAY "A", ONTARIO YEAR/ANNÉE: 1983

METEOROLOGICAL DATA FOR THE YEAR / DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE

MONTH MOIS	SUNSHINE / INSOLATION				WIND / VENT							
							NORMAL MORMALE		MAX FOR 1 MIN MAX POUR 1 MIN		HIGHEST GUST RAFALE MAXIMUM	
	DURATION IN HOURS DURÉE (NOMBRE D'HEURES)	PERCENTAGE OF POSSIBLE POURCENTAGE DU TOTAL POSSIBLE	NO. OF DAYS WITHOUT SUNSHINE NOMBRE DE JOURS SANS SOLEIL	NORMAL NORMALE	AVERAGE SPEED VITESSE MOYENNE	PREVAILING DIRECTION DIRECTION DOMINANTE	SPEED VITESSE	DIRECTION	DIRECTION AND SPEED DIRECTION ET VITESSE	DATE	DIRECTION AND SPEED DIRECTION ET VITESSE	DATE
JAN/JAN	102.8	37.2	12	118.4	11.8	W	14.1	W	W 48	4	W 69	4
FEB/FÉV	70.5	24.6	14	146.7	11.9	E	13.5	W	ENE 33	19	NNE 48	2
MAR/MAR	112.8	30.6	13	172.8	14.7	ENE	13.8	E	ENE 46	6	E 69	6
APR/AVR	182.7	44.6	6	215.4	14.0	E	14.9	E	SVRL 37	S	N 59	14
MAY/MAI	284.3	60.4	4	252.2	13.0	E	14.7	E	SVRL 37	S	N 59	30
JUN/JUIN	261.8	54.7	1	262.0	11.3	E	12.4	E	W 35	6	W 70	6
JUL/JUIL	314.9	65.2	0	303.7	10.9	W	11.6	W	SVRL 35	4	SVRL 59	11
AUG/AOÛT	296.2	67.0	2	255.9	9.6	WSW	11.2	W	W 46	19	WSW 61	19
SEPT/SEP	157.1	41.7	3	167.9	11.6	W	12.3	W	SVRL 39	S	W 63	10
OCT/OCT	135.6	40.4	5	127.9	11.2	W	13.4	W	WNW 52	28	WNW 67	28
NOV/NOV	52.1	18.7	16	86.5	16.3	WSW	14.3	W	SVRL 48	24	SW 76	24
DEC/DÉC	117.5	44.8	7	93.4	16.8	W	14.0	W	W 54	24	W 78	24
YEAR ANNÉE	2088.3	46.7	83	2202.8	12.8	W	13.4	W	W 54	Dec. 24	W 78	Dec. 24

MONTH MOIS	BAROMETRIC PRESSURE*/PRESSION BAROMÉTRIQUE*											
	STATION LEVEL / NIVEAU DE LA STATION						SEA LEVEL / NIVEAU DE LA MER					
	MEAN MOYENNE	MAXIMUM MAXIMALE	DATE	MINIMUM MINIMALE	DATE	NORMAL NORMALE	MEAN MOYENNE	MAXIMUM MAXIMALE	DATE	MINIMUM MINIMALE	DATE	NORMAL NORMALE
JAN/JAN	99.41	101.34	18	97.28	10	99.31	101.96	104.02	18	99.69	10	101.86
FEB/FÉV	99.37	100.45	21	98.00	13	99.28	101.91	102.97	21	100.44	13	101.81
MAR/MAR	99.32	100.62	29	97.42	S	99.26	101.83	103.17	29	99.83	7	101.75
APR/AVR	99.04	100.32	5	97.11	14	99.07	101.51	102.81	5	99.55	14	101.51
MAY/MAI	99.08	100.49	8	97.81	S	99.09	101.52	102.97	8	100.36	22	101.50
JUN/JUIN	98.98	99.98	27	97.59	30	98.63	101.38	102.42	27	99.95	30	101.32
JUL/JUIL	98.95	100.07	9	96.68	4	99.02	101.33	102.48	9	99.03	4	101.38
AUG/AOÛT	99.21	99.92	9	97.98	7	99.08	101.59	102.37	9	100.29	7	101.45
SEPT/SEP	98.98	100.25	13	97.28	6	99.14	101.39	102.79	14	99.62	6	101.53
OCT/OCT	99.43	101.06	S	97.40	27	99.08	101.88	103.60	19	99.78	27	101.49
NOV/NOV	98.90	101.35	3	94.84	23	99.05	101.37	103.87	3	97.19	24	101.52
DEC/DÉC	99.43	101.57	19	97.82	26	99.23	102.01	104.31	19	100.35	26	101.75
YEAR ANNÉE	99.18	101.57	Dec. 19	94.84	Nov. 23	99.13	101.64	104.31	Dec. 19	97.19	Nov. 24	101.57

*1 Kilopascal = 0.29529 inches of mercury / 3.386 kilopascals = 1 inch of mercury
= 0.29529 pouces de mercure / 3.386 kilopascals = 1 pouce de mercure

S = several occurrences

ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL

for/pour THUNDER BAY "A", ONTARIO YEAR/ANNÉE: 1983

METEOROLOGICAL DATA FOR THE YEAR / DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE												
DAILY MAXIMUM TEMPERATURES / TEMPERATURES MAXIMALES QUOTIDIENNES												
DATE	JAN JAN	FEB FEV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEPT SEP	OCT OCT	NOV NOV	DEC DEC
1	-5.6	-4.3	-7.6	2.3	10.1	19.9	21.1	29.3	30.1	19.8	12.6	-5.9
2	-11.7	-8.2	-2.4	8.2	16.3	21.6	16.0	29.9	31.4	14.4	10.9	-8.1
3	-3.9	-13.1	-1.5	6.2	14.5	16.0	24.2	27.5	29.5	10.6	1.9	-2.3
4	0.5	-12.9	0.6	7.3	8.5	10.4	18.8	24.8	26.7	8.3	6.1	-1.7
5	-1.8	-12.4	5.1	7.9	11.4	16.7	20.7	33.2	23.9	14.4	11.1	-7.4
6	-0.1	-14.2	5.0	4.0	8.6	19.4	24.1	31.0	22.7	10.0	12.9	-10.9
7	-4.9	-7.7	4.3	7.8	12.2	17.0	30.6	40.3	22.1	7.3	10.1	-9.0
8	-1.7	-10.4	7.6	9.3	9.5	10.2	26.6	26.3	26.0	11.2	10.0	-7.9
9	2.1	-9.5	-5.5	7.5	8.7	15.9	21.4	21.1	21.7	15.3	2.1	-15.6
10	2.0	-3.5	-1.9	3.8	14.8	20.6	20.2	16.8	24.0	12.0	-1.5	-11.0
11	-4.0	-1.6	-0.4	8.8	16.0	29.4	33.8	23.8	18.0	13.9	-1.1	-1.1
12	-9.1	0.3	5.1	3.2	15.1	22.1	30.7	26.6	16.0	5.3	1.2	-2.0
13	-10.2	3.6	3.2	2.6	18.0	26.7	33.4	27.4	13.8	6.4	1.2	-7.3
14	-10.0	4.8	2.1	0.3	11.7	23.8	34.1	29.3	15.8	5.7	2.7	-6.8
15	-13.4	1.7	1.2	-2.1	6.7	21.7	24.8	27.1	15.0	6.9	3.9	-9.1
16	-9.9	3.3	-0.3	-2.4	8.9	16.8	25.8	28.1	15.1	11.7	0.8	-16.8
17	-16.4	2.1	1.4	-0.3	16.1	16.1	29.3	26.5	13.3	8.7	0.2	-19.9
18	-17.4	-4.7	0.1	1.8	21.8	21.0	29.1	29.2	17.6	6.2	3.1	-24.4
19	-5.3	-3.1	-4.4	5.7	12.1	19.4	27.7	30.0	12.8	7.7	5.2	-22.2
20	-2.5	0.1	-3.6	8.0	10.5	21.0	29.8	22.7	13.7	9.4	5.6	-18.6
21	-3.2	-2.1	-5.9	11.7	11.8	21.9	24.9	18.6	10.0	10.8	0.6	-5.9
22	-1.3	3.6	-4.8	11.7	12.4	31.5	27.1	24.3	9.4	9.6	-1.4	-10.1
23	0.5	0.9	-6.6	11.3	19.7	28.6	26.4	26.6	14.7	11.2	7.1	-21.5
24	-1.1	-4.4	-4.7	11.8	11.3	29.3	25.3	24.2	16.7	13.4	-1.3	-20.1
25	-14.4	-4.4	2.3	21.9	13.3	25.2	29.3	29.2	24.1	10.5	-3.3	-15.4
26	-15.9	1.2	5.9	13.5	13.3	22.8	28.8	29.6	23.5	12.4	-2.7	-8.2
27	-6.3	2.5	2.4	11.6	15.9	17.4	31.8	29.9	18.1	20.0	-1.3	-11.0
28	-0.3	-1.0	1.2	12.9	7.8	21.3	28.2	28.8	22.8	8.0	-3.1	-13.1
29	1.2		2.4	7.6	14.5	18.8	31.2	22.1	17.2	8.4	-4.2	-15.8
30	-1.4		0.7	10.4	14.6	20.3	21.8	24.7	12.4	13.2	-4.3	-8.0
31	-7.0		2.7		19.2		23.9	27.4		12.8		-10.4

ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL

for/pour THUNDER BAY "A", ONTARIO YEAR/ANNÉE: 1983

METEOROLOGICAL DATA FOR THE YEAR/DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE													
NUMBER OF DAYS WITH: NOMBRE DE JOURS AVEC:	JAN JAN	FEB FÉV	MAR MAR	APR AVR	MAY MAI	JUN JUIL	JUL JUIL	AUG AOÛT	SEPT SEP	OCT OCT	NOV NOV	DEC DÉC	YEAR ANNÉE
MEASURABLE RAIN PLUIE, MESURABLE	3	2	7	4	8	13	10	9	17	17	5	0	95
RAIN (Trace or More) PLUIE (Trace ou davantage)	5	5	10	5	14	15	11	13	18	19	9	0	124
MEASURABLE SNOW NEIGE, MESURABLE	14	10	7	6	0	0	0	0	0	2	10	11	60
SNOW (Trace or More) NEIGE (Trace ou davantage)	23	16	13	8	0	0	0	0	2	3	18	22	105
MEASURABLE PRECIPITATION PRÉCIPITATION, MESURABLE	14	10	12	8	8	13	10	9	17	17	10	9	137
PRECIPITATION (Trace or More) PRÉCIPITATION (Trace ou davantage)	23	17	17	10	14	15	11	13	18	19	20	22	199
THUNDERSTORMS ORAGES	0	0	0	0	0	3	7	4	6	2	0	0	22
HAIL GRÊLE	0	0	0	0	0	0	0	1	0	0	0	0	1
ICE PELLETS GRANULES DE GLACE	1	1	2	1	0	0	0	0	2	2	1	0	10
FREEZING PRECIPITATION PRÉCPITATION VERGLACANTE	3	3	2	0	0	0	0	0	0	0	2	0	10
FOG* BROUILLARD*	3	2	5	1	2	5	3	3	5	4	0	0	33
MAXIMUM TEMPERATURE TEMPÉRATURE MAXIMALE 30°C OR MORE/OU PLUS	0	0	0	0	0	1	7	4	2	0	0	0	14
MAXIMUM TEMPERATURE TEMPÉRATURE MAXIMALE 0°C OR LESS/OU MOINS	26	17	13	3	0	0	0	0	0	0	10	31	100
MINIMUM TEMPERATURE TEMPERATURE MINIMALE 0°C OR LESS/OU MOINS	31	28	27	28	19	1	0	0	3	16	26	31	210
MINIMUM TEMPERATURE TEMPERATURE MINIMALE -15°C OR LESS/OU MOINS	22	11	6	2	0	0	0	0	0	0	1	27	69

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*NOTE: Fog is only counted when the visibility is restricted to ½ mile or less

ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL

for/pour THUNDER BAY "A", ONTARIO YEAR/ANNÉE: 1983

METEOROLOGICAL DATA FOR THE YEAR / DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE

DAILY MINIMUM TEMPERATURES / TEMPERATURES MINIMALES QUOTIDIENNES

DATE	JAN JAN	FEB FEV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEPT SEP	OCT OCT	NOV NOV	DEC DEC
1	-18.0	-20.9	-14.8	-2.3	-3.5	0.9	13.7	15.6	11.4	11.2	2.9	-14.4
2	-27.6	-16.7	-8.5	-4.4	-2.7	2.8	11.8	15.0	16.6	8.2	-1.1	-19.1
3	-17.5	-20.0	-3.9	1.1	-2.9	6.3	11.3	17.9	17.3	6.5	-8.0	-21.8
4	-4.2	-26.3	-2.9	-1.4	-0.2	8.1	4.1	16.1	10.5	4.3	-9.4	-12.4
5	-5.2	-24.0	0.1	-2.7	-5.0	7.0	2.7	15.1	12.7	5.4	-6.8	-20.2
6	-5.0	-29.4	2.1	-0.2	-3.7	2.9	4.6	17.5	10.6	1.0	-0.6	-22.3
7	-16.7	-29.4	1.2	-1.2	-0.1	2.5	11.0	13.0	10.0	1.2	-4.4	-22.5
8	-19.4	-18.4	-6.6	-4.5	-3.4	-0.6	14.6	11.3	6.9	-2.1	1.5	-20.8
9	-2.0	-17.4	-10.4	-7.0	-5.9	4.0	8.6	7.7	16.6	-2.0	-4.7	-27.4
10	-4.0	-9.8	-14.6	0.8	-2.5	1.5	9.4	14.3	13.0	6.5	-8.4	-26.9
11	-22.0	-5.7	-16.1	-3.8	-1.0	7.2	12.5	9.5	6.1	5.0	-12.0	-11.6
12	-24.1	-5.7	-10.0	-3.9	-0.3	10.1	15.5	10.5	3.9	2.6	-15.0	-18.4
13	-23.4	-0.8	-3.7	-0.1	5.5	11.0	12.0	9.0	0.4	0.9	-12.0	-16.8
14	-25.2	-1.1	-5.4	-6.5	-1.5	13.0	16.6	16.2	0.8	-3.5	0.0	-9.1
15	-25.3	-2.2	-5.0	-8.0	-4.9	8.6	16.0	12.5	1.1	-5.2	-0.1	-19.2
16	-18.4	-0.3	-3.4	-14.0	-5.7	8.6	15.0	14.0	8.0	4.5	-3.7	-22.5
17	-25.9	-8.9	-2.4	-18.4	-5.9	7.4	17.2	15.5	2.3	-3.2	-5.7	-27.6
18	-29.0	-9.7	-5.6	-16.4	1.2	5.3	15.0	14.4	8.3	-4.7	-0.2	-31.9
19	-28.0	-8.0	-9.2	-12.7	7.3	4.9	15.8	16.3	7.0	-6.7	1.3	-33.3
20	-18.2	-5.2	-13.4	-6.3	5.0	5.9	14.0	12.9	3.3	-2.7	0.2	-30.3
21	-19.9	-4.8	-17.2	-1.4	4.3	12.1	13.2	14.1	2.2	-5.0	-4.1	-23.9
22	-18.0	-2.9	-16.6	-1.1	4.7	11.9	9.9	12.0	-1.5	0.4	-4.1	-23.4
23	-5.2	-8.4	-15.6	-2.4	4.6	13.7	13.6	10.6	-3.0	-2.9	-2.4	-27.6
24	-15.2	-14.1	-20.4	-3.0	0.8	13.3	13.3	10.6	-2.3	-0.9	-6.7	-24.3
25	-24.3	-19.9	-16.0	-1.6	-2.1	14.1	11.4	14.0	2.2	0.8	-8.0	-27.2
26	-24.4	-18.4	-9.7	-1.7	-1.4	8.9	12.8	17.2	4.7	-1.0	-10.5	-17.8
27	-27.6	-1.0	-4.1	-1.3	-1.6	4.1	14.4	15.6	2.5	0.6	-10.4	-21.7
28	-6.6	-13.6	-8.4	-2.4	5.2	5.0	17.0	13.9	12.0	-0.7	-5.4	-22.8
29	-1.4		-10.4	-0.2	6.2	4.0	16.8	14.4	10.8	-4.4	-6.2	-26.3
30	-11.6		-3.0	-1.1	7.9	12.6	14.0	13.1	10.2	-5.5	-8.2	-19.7
31	-18.8		0.0		3.8		15.8	10.7		-2.6		-21.6

ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL

for/pour THUNDER BAY "A", ONTARIO YEAR/ANNÉE: 1983

METEOROLOGICAL DATA FOR THE YEAR / DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE

DAILY MEAN TEMPERATURES / TEMPERATURES MOYENNES QUOTIDIENNES

DATE	JAN JAN	FEB FEV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEPT SEP	OCT OCT	NOV NOV	DEC DEC
1	-11.8	-12.6	-11.2	0.0	3.3	10.4	17.4	22.5	20.8	15.5	7.8	-10.2
2	-19.7	-12.5	-5.5	1.9	6.8	12.2	13.9	22.5	24.0	11.3	4.9	-13.6
3	-10.7	-16.6	-2.7	3.7	5.8	11.2	17.8	22.7	23.4	8.6	-3.1	-12.1
4	-1.9	-19.6	-1.2	3.0	4.2	9.3	11.5	20.5	18.6	6.3	-1.7	-7.1
5	-3.5	-18.2	2.6	2.6	3.2	11.9	11.7	24.2	18.3	9.9	2.2	-13.8
6	-2.6	-21.8	3.6	1.9	2.5	11.2	14.4	24.3	16.7	5.5	6.2	-16.6
7	-10.8	-18.6	2.8	3.3	6.1	9.8	20.8	26.7	16.1	4.3	2.9	-15.8
8	-10.6	-14.4	0.5	2.4	3.1	4.8	20.6	18.8	16.5	4.6	5.8	-14.4
9	0.1	-13.5	-8.0	0.3	1.4	10.0	15.0	14.4	19.2	6.7	-1.3	-21.5
10	-1.0	-6.7	-8.3	2.3	6.2	11.1	14.8	15.6	18.5	9.3	-5.0	-19.0
11	-13.0	-3.7	-8.3	2.5	7.5	18.3	23.2	16.7	12.1	9.5	-6.6	-6.4
12	-16.6	-2.7	-2.5	-0.4	7.4	16.1	23.1	18.6	10.0	4.0	-6.9	-10.2
13	-16.8	1.4	-0.3	1.3	11.8	18.9	22.7	18.2	7.1	3.7	-5.4	-12.1
14	-17.6	1.9	-1.7	-3.1	5.1	18.4	25.4	22.8	8.3	1.1	1.4	-8.0
15	-19.4	-0.3	-1.9	-5.1	0.9	15.2	20.4	19.8	8.1	0.9	1.9	-14.2
16	-14.2	1.5	-1.9	-8.2	1.6	12.7	20.4	21.1	11.6	8.1	-1.5	-19.7
17	-21.2	-3.4	-0.5	-9.4	5.1	11.8	23.3	21.0	7.8	2.8	-2.8	-23.8
18	-23.2	-7.2	-2.8	-7.3	11.5	13.2	22.1	21.8	13.0	0.8	1.5	-28.2
19	-16.7	-5.6	-6.8	-3.5	9.7	12.2	21.8	23.2	9.9	0.5	3.3	-27.8
20	-10.4	-2.6	-8.5	0.9	7.8	13.5	21.9	17.8	8.5	3.4	2.9	-24.5
21	-11.6	-3.5	-11.6	5.2	8.1	17.0	19.1	16.4	6.1	2.9	-1.8	-14.9
22	-9.7	0.4	-10.7	5.3	8.6	21.7	18.5	18.2	4.0	5.0	-2.8	-16.8
23	-2.4	-3.8	-11.1	4.5	12.2	21.2	20.0	18.6	5.9	4.2	2.4	-24.6
24	-8.2	-9.3	-12.6	4.4	6.1	21.3	19.4	17.4	7.2	6.3	-4.0	-22.2
25	-19.4	-12.2	-6.9	10.2	5.6	19.7	20.4	21.6	13.2	5.7	-5.7	-21.3
26	-20.2	-8.6	-1.9	5.9	6.0	15.9	20.8	23.4	14.1	5.7	-6.6	-13.0
27	-17.0	0.8	-0.9	5.2	7.2	10.8	23.1	22.8	10.3	10.3	-5.9	-16.1
28	-3.5	-7.3	-3.6	5.3	6.5	13.2	22.6	21.4	17.4	3.7	-4.3	-18.0
29	-0.1		-4.0	3.7	10.4	11.4	24.0	18.3	14.0	2.0	-5.2	-21.1
30	-6.5		-1.2	4.7	11.3	16.5	17.9	18.9	11.3	3.9	-6.3	-13.9
31	-12.9		1.4		11.5		19.9	19.1		5.1		-16.0

ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL

for/pour THUNDER BAY "A", ONTARIO YEAR/ANNÉE: 1983

METEOROLOGICAL DATA FOR THE YEAR / DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE

DAILY RAINFALL / CHUTES DE PLUTE QUOTIDIENNES

DATE	JAN JAN	FEB FEV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEPT SEP	OCT OCT	NOV NOV	DEC DEC
1				TR						2.2		
2						TR	5.4	15.6		7.2	TR	
3			0.4		TR	8.6	26.8	4.6	0.2	2.4		
4			0.6		TR	18.1	6.6		2.6	0.2		
5			1.2			0.8			4.6	2.3		
6			16.4			0.4				0.2		
7			13.6				0.2	14.8		6.3		
8			TR			5.2			0.7	TR		
9	2.4								7.7			
10	0.2			5.5		0.2		38.9	20.5	3.6		
11										13.7		
12					TR	TR				7.4		
13			0.2	0.2	0.4			TR	4.3	9.6	TR	
14		TR	TR		TR	1.3				0.8	0.3	
15						3.6			1.6	7.8	TR	
16		TR				0.4	5.6		5.4	1.0		
17					TR				0.3	0.2		
18					TR		0.4	TR	TR		TR	
19					0.9			12.6			9.6	
20		TR			4.4				0.6		30.5	
21								12.3	0.2			
22					11.2	2.1			0.4			
23	TR						0.4				32.2	
24					3.4			0.8		1.0		
25						10.1						
26						7.2		0.2		TR		
27		4.6					13.4	TR	0.4			
28	TR	0.2			10.6		0.8	TR	1.4	0.5	0.7	
29	1.4				11.1			8.2	17.1			
30			TR		5.9	9.9	TR		15.8			
31			0.3				2.8					

ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL

for/pour THUNDER BAY "A", ONTARIO YEAR/ANNÉE: 1983

METEOROLOGICAL DATA FOR THE YEAR / DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE

DAILY SNOWFALL / CHUTES DE NEIGE QUOTIDIENNES

DATE	JAN JAN	FEB FEV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEPT SEP	OCT OCT	NOV NOV	DEC DEC
1	2.0		TR	2.6								TR
2		TR	0.4									TR
3	0.4		3.8									0.2
4	1.4		TR									
5	TR	0.8										TR
6	3.3			TR								
7	TR			TR								
8			TR									0.2
9	1.7	1.9	4.1								2.6	
10	2.8	4.0		1.8								2.8
11		2.5									TR	20.4
12	3.4	TR										TR
13	2.6			13.8						1.3	2.0	6.6
14	4.6	TR	TR	20.6						7.0	0.2	0.2
15		TR		1.2								1.0
16	4.2		TR	0.2							TR	0.2
17	TR	0.2	2.0								TR	TR
18		5.2	0.6								TR	TR
19	0.4	10.4									0.4	
20		6.9									3.4	
21	TR	TR							TR		4.8	11.8
22									TR		3.3	1.6
23	TR	TR									4.6	TR
24	TR										TR	TR
25	TR											1.0
26											TR	TR
27	TR	0.8	TR								TR	
28	TR	0.4								TR	6.7	TR
29	10.4										2.6	TR
30	0.4		1.6								TR	
31	0.2		0.3									

ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL

for/pour THUNDER BAY "A", ONTARIO YEAR/ANNÉE: 1983

METEOROLOGICAL DATA FOR THE YEAR / DONNÉES MÉTÉOROLOGIQUE POUR L'ANNÉE

TOTAL DAILY PRECIPITATION OF RAIN & SNOW / PRECIPITATION TOTALE DE PLUIE ET DE NEIGE

DATE	JAN JAN	FEB FEV	MAR MAR	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOÛT	SEPT SEP	OCT OCT	NOV NOV	DEC DEC
1	1.4		TR	2.8						2.2		TR
2		TR	0.4			TR	5.4	15.6		7.2	TR	TR
3	0.2		4.0		TR	8.6	26.8	4.6	0.2	2.4		0.2
4	0.8		0.6		TR	18.1	6.6		2.6	0.2		
5	TR	0.8	1.2			0.8			4.6	2.3		TR
6	3.2		16.4	TR		0.4				0.2		
7	TR		13.6	TR			0.2	14.8		6.3		
8			TR			5.2			0.7	TR		TR
9	4.1	1.6	1.9						7.7		2.5	
10	3.2	2.4		7.3		0.2		38.9	20.5	3.6		1.9
11		2.0								13.7	TR	19.4
12	1.4	TR			TR	TR				7.4		TR
13	2.6		0.2	16.7	0.4			TR	4.3	10.9	2.0	5.5
14	4.6	TR	TR	23.0	TR	1.3				7.8	0.5	TR
15		TR		1.0		3.6			1.6	7.8	TR	1.0
16	2.0	TR	TR	0.2		0.4	5.6		5.4	1.0	TR	0.2
17	TR	0.2	1.6		TR				0.3	0.2	TR	TR
18		4.5	0.2		TR		0.4	TR	TR		TR	TR
19	0.2	9.8			0.9			12.6			10.0	
20		6.9			4.4				0.6		33.9	
21	TR	TR						12.3	0.2		4.2	7.7
22					11.2	2.1			0.4		3.3	1.0
23	TR	TR					0.4				37.5	TR
24	TR				3.4	10.1		0.8		1.0	TR	TR
25	TR											0.8
26				5.0		7.2		0.2		TR	TR	TR
27	TR	5.4	TR				13.4	TR	0.4		TR	
28	TR	0.6		3.4	10.6		0.8	TR	1.4	0.5	7.2	TR
29	12.8				11.1			8.2	17.1		2.6	TR
30	0.4		1.4		5.9	9.9	TR		15.8		TR	
31	0.2		0.6				2.8					

ANNUAL METEOROLOGICAL SUMMARY
SOMMAIRE MÉTÉOROLOGIQUE ANNUEL

for/pour THUNDER BAY "A", ONTARIO YEAR/ANNÉE: 1983

MONTHLY AND ANNUAL EXTREMES OF RECORD / EXTRÊMES MENSUELLES ET ANNUELLES AUX REGISTRES

MONTH MOIS	TEMPERATURE / TEMPÉRATURE								PRECIPITATION / PRÉCIPITATIONS					
	ABSOLUTE MAXIMUM ABSOLU	YEAR ANNÉE	ABSOLUTE MINIMUM ABSOLU	YEAR ANNÉE	HIGHEST MONTHLY MEAN MOYENNE MENSUELLE MAXIMALE	YEAR ANNÉE	LOWEST MONTHLY MEAN MOYENNE MENSUELLE MINIMALE	YEAR ANNÉE	GREATEST MONTHLY PRECIPITATION MENSUELLE MAXIMALE	YEAR ANNÉE	LEAST MONTHLY PRECIPITATION MENSUELLE MINIMALE	YEAR ANNÉE	GREATEST MONTHLY SNOWFALL NEIGE MENSUELLE MAXIMALE	YEAR ANNÉE
JAN/JAN	8.3	1942	-41.1	1951	-7.0	1944	-21.1	1982	143.3	1956	4.3	1944	143.3	1956
FEB/FÉV	12.2	1976	-40.0	1970	-4.8	1981	-18.7	SVRL	81.0	1951	3.8	1978	70.4	1951
MAR/MAR	22.8	1946	-36.7	1943	-0.6	1973	-10.6	1943	102.9	1979	8.1	1969	87.6	1955
APR/AVR	28.3	1965	-22.2	1954	5.7	1955	-2.2	1950	136.9	1964	15.7	1944	79.2	1950
MAY/MAI	34.8	1980	-8.9	SVRL	12.0	1977	5.6	1967	174.2	1971	9.2	1976	34.8	1954
JUN/JUIN	35.6	1956	-2.8	1949	15.9	1955	10.8	1969	180.8	1944	30.5	1955	TR	1969
JUL/JUIL	37.2	1975	0.0	1969	19.7	SVRL	15.2	1965	200.3	1982	7.4	1981	0.0	
AUG/AOÛT	40.3	1983	-1.1	1976	20.3	1983	13.6	1977	168.6	1977	27.0	1976	0.0	
SEPT/SEP	31.7	1976	-8.3	SVRL	13.7	1948	8.4	1974	284.2	1977	22.4	1952	1.5	1942
OCT/OCT	28.3	1943	-13.3	SVRL	10.5	1963	2.7	1976	166.6	1970	5.3	1947	22.6	SVRL
NOV/NOV	21.7	1975	-30.6	1976	0.7	SVRL	-7.6	1959	128.5	1958	7.9	1968	85.3	1950
DEC/DÉC	12.2	1962	-37.8	1976	-5.4	1952	-17.2	1976	105.9	1948	10.4	1960	119.9	1968
YEAR ANNÉE	40.3	Aug. 1983	-41.1	Jan. 1951	20.3	Aug. 1983	-21.1	Jan. 1982	284.2	Sept 1977	3.8	Feb. 1978	143.3	Jan. 1956

PERIOD OF RECORD/PÉRIOD DE REGISTRE: 1941-1983

POOR

QUALITY

ORIGINAL